SCIENTIFIC AMERICAN

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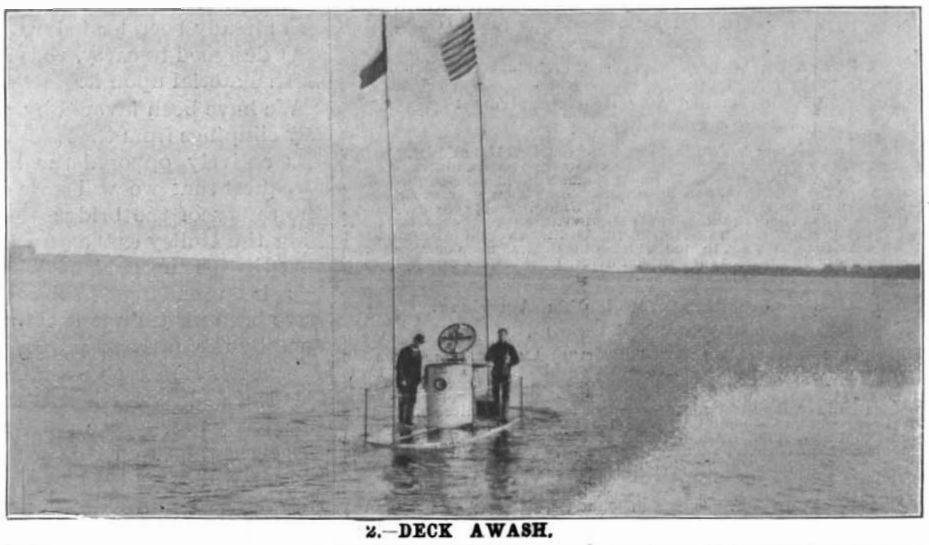
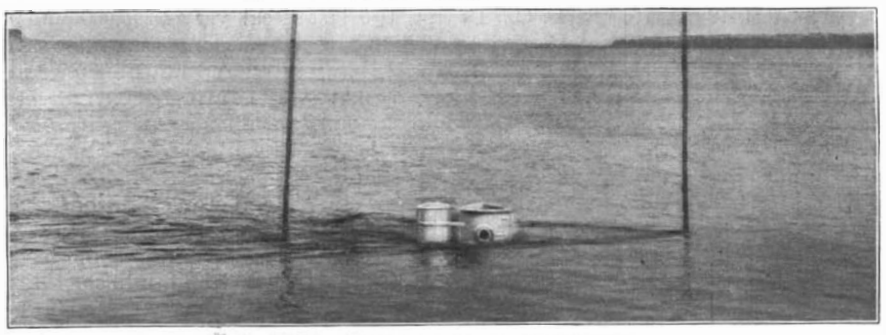
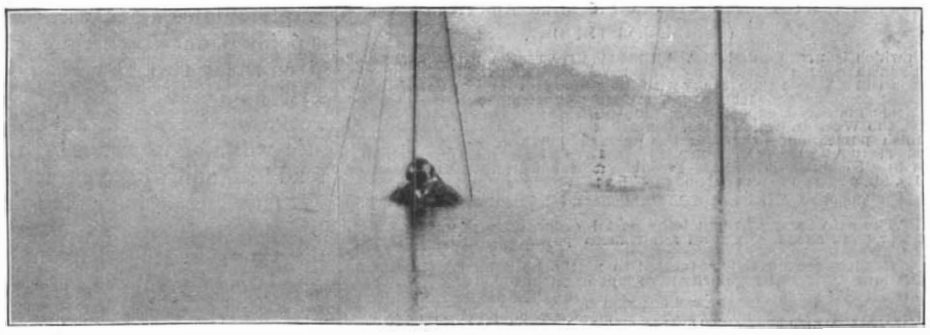
1.—FULL SPEED WITH DRY DECK.



2.—DECK AWASH.



3.—FULL SPEED, DECK SUBMERGED.



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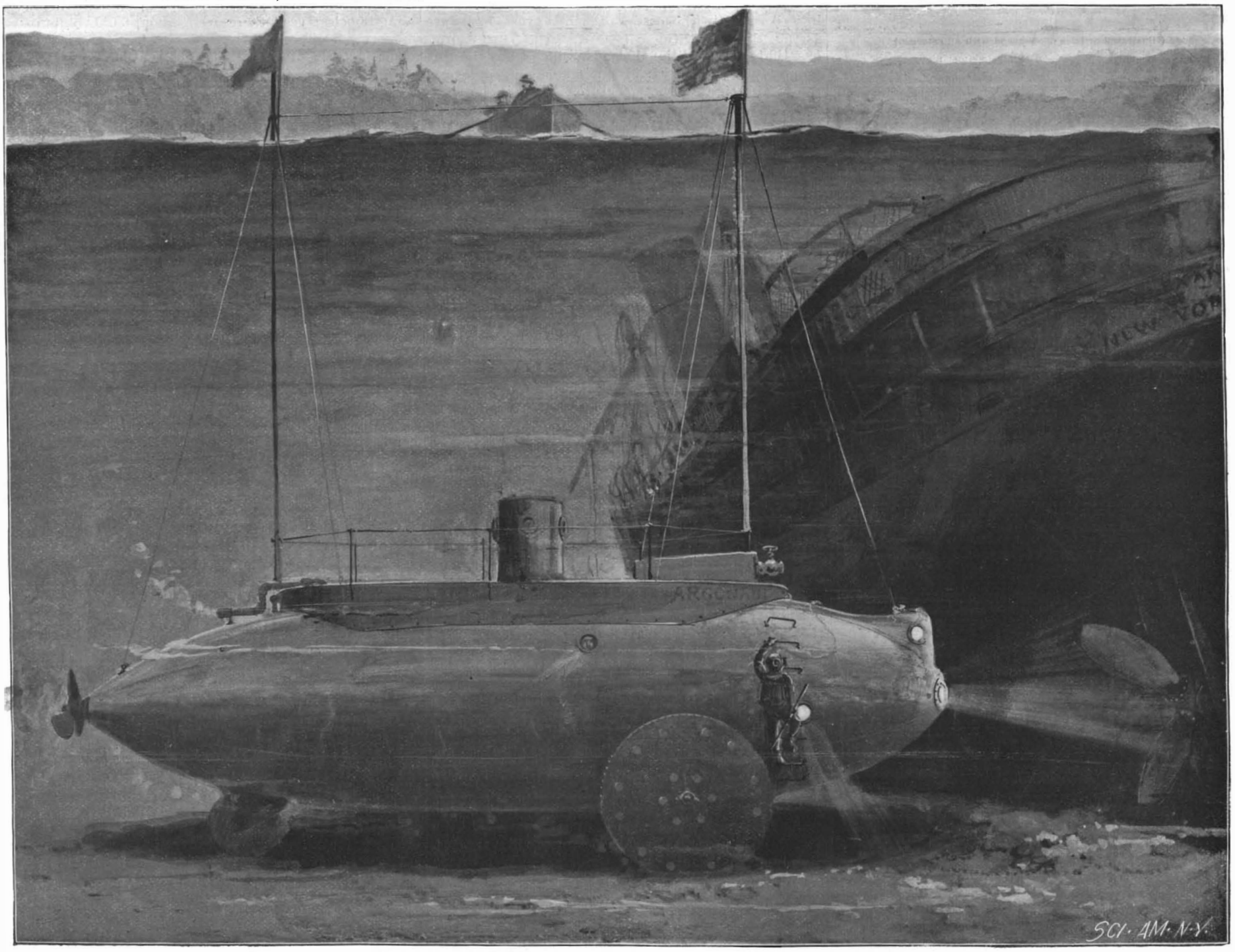

5.—LAKE'S SUBMARINE WRECKING-BOAT.

A NEW METHOD OF SALVAGE OPERATIONS.—[See page 22.

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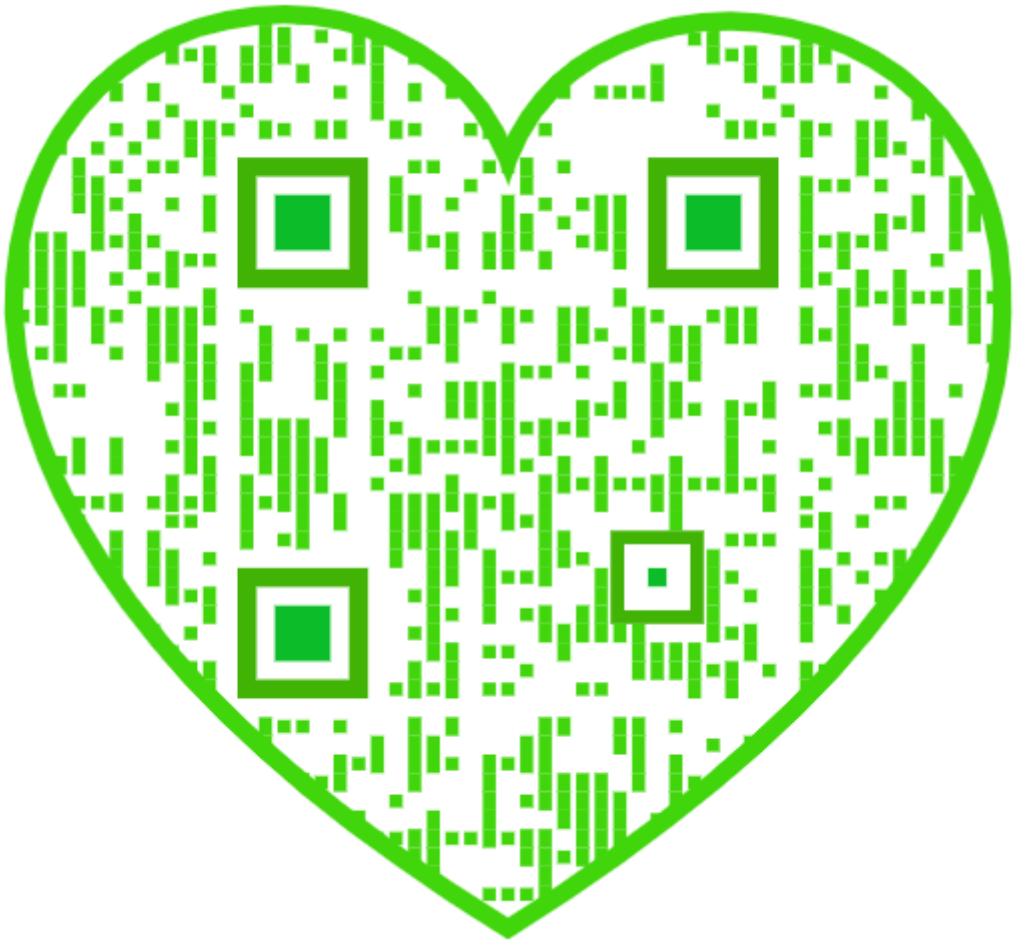

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STRENGTH OF THE NEW YORK AND BROOKLYN SUSPENSION BRIDGE.

The permission which has been granted by the trustees of the New York and Brooklyn Suspension Bridge to the Brooklyn trolley companies to run their cars across the structure has aroused opposition on various grounds, the most serious of which is that it is not strong enough to carry safely the increased loads which will be put upon it.

This is a most serious objection (provided, of course, that it is well founded) for the reason that all the others are based upon alleged inconveniences of a minor character, whereas this is one which can only be neglected at the peril of the lives of the citizens. If the bridge has already been loaded with greater weights than it was designed to carry, this is certainly no time to lay fresh material upon it.

We have been favored by a correspondent with sundry clippings from that section of the local press which has actively opposed the laying of the tracks with a request that we will state our opinion as to whether the safety of the bridge would be imperiled by running the trolley cars across it. In reply we must state that there is no evidence that the safety of the bridge has been endangered by the extra weights which have been placed upon it in the past, nor is it threatened by the present proposal to run a line of trolley cars across it in each direction.

It is urged that whereas the bridge was designed to carry only four rails on which to run cars it now carries eight rails, and that when the trolley cars are running it will carry twelve rails. To this is to be added the weight of four extra hauling cables, two in use and two in reserve, and also the weight of the various telegraph and telephone wires which cross the bridge. It is pointed out furthermore that permission has been given to lay two lines of 8-inch cast iron tubes for the service of the Tubular Dispatch Company, of New York. It is claimed that these additions to the structure will add from one to two thousand tons to the dead load and will strain it beyond the limit of safety.

It may be said in general regarding all reports of the insecurity of the greater engineering works, especially those in the domain of bridge building, that popular fears for the safety of a structure are apt to increase in proportion to its size and bulk. As a matter of fact, however, the larger bridge is likely to be the safer, especially in respect of overloading, because in the case of such a vast structure as the Brooklyn Bridge its own weight is so enormous that any additional loads which may be put upon it will probably add but a small percentage to the total weight of the structure. Thus, if the eight lines of rails, the four extra cables, the pneumatic tubes and the telegraph wires were to be laid across a country highway bridge weighing so many hundred pounds to the foot, they would make some inroads upon the "factor of safety" so called; but when this addition is made to a sixteen hundred foot span, weighing so many tons to the foot, as in the case of the Brooklyn Bridge, the increase in the strains upon the individual members of the bridge is so slight as to become a practically negligible quantity. The weight of the central span is 5878 tons. The combined weight of all the extra loads above mentioned which have been or are to be placed upon the bridge does not add more than about five or six per cent to the total estimated dead weight of the main span. In view of the fact that the bridge was made strong enough to carry four times its own weight, plus four times the weight of all the cars, loaded drays, and foot passengers that could come upon it before breaking down, it is evident that the increase in dead weight which has occurred in nowise imperils the safety of the structure.

When we come to consider the question of the increase of live or moving loads, due to the weight of the trolley cars, the unexpected fact is disclosed that such a line of cars would not equal the assumed loading for which Mr. Roebling originally designed the floor of the structure. The floor is carried upon continuous latticed floor beams, which are spaced about 7½ feet apart and run transversely across the whole bridge. Each of these was designed to carry a maximum load of forty-four tons distributed as follows: Four tons on a pair of dray wheels placed next the outside cables, ten tons on a pair of wheels placed next the cable road trusses and eight tons on each pair of cable car wheels.

The maximum axle load of the Brooklyn trolleys, however, is only five tons, or just one-half that which was assumed in designing the floor of the bridge. Nor would the suspenders or the main cables be more seriously strained than they would under the maximum loading for which the bridge was designed. The weight of the moving trolley cars will be so distributed by the rigid floor beams and the longitudinal trusses that the strains in the suspenders and cables will vary but slightly from those due to the maximum assumed loads.

It is being urged that placing trolley lines on the inside of the roadway brings an undue share of the load upon the inner cables. The flexibility of the cables and the rigidity of the floor, however, so affect the distribution of the load that the effect upon the cables would be practically the same whether the tracks were laid on the outside or inside of the roadway. This is shown by a model which can be seen at the office of the engineers of the bridge. A strip of hard rubber, representing a floor beam, is suspended by scales at points representing the points of attachment of the suspenders to the floor of the bridge. If a weight be placed at two different positions, corresponding to the inside and outside of the roadway, the reading of the scales shows that the effect upon the inner cable will be no greater when the car is placed on the inside than when it is placed on the outside of the roadway.

The Brooklyn Bridge is a monument of the genius and skill of its builders, and the fact that it was provided with a margin of strength so liberal as to allow of another set of lines being operated whenever the increase of travel should demand it, is a testimony to the far-sightedness of its eminent designers and builders. Whether, in view of the great improvement recently carried out in the operation of the cable road, the time is yet ripe for the laying down of further lines, we do not undertake to say; but that the growing travel will soon demand this enlarged accommodation no one can seriously deny.

THE WEATHER BUREAU IN 1897.

The Weather Bureau of the Department of Agriculture is to the average citizen one of the most important of the bureaus, and it is remarkable that so much can be accomplished by an appropriation of $883,772. It is significant that the appropriation for 1896–97 was $109,748 less than in 1883. In 1883 the weather maps were not issued except at the central office in Washington, D. C. During the last fiscal year 4,315,000 maps were issued to eighty-one stations outside of Washington, D. C. In 1883, forecasts and warnings were sent to 8,094 places by mail, while during the last fiscal year the daily forecasts and warnings were sent to 51,694 places, by mail, telegraph, telephone, etc. In 1883 no information was collected respecting the weather as influencing crops; now climate and crop conditions are reported from about 8,000 places and results are summarized in the weekly Climate and Crop Bulletins, which are issued at each State center and published by practically the entire press of the country, both rural and urban. In the former year there were less than 300 voluntary observers in co-operation with the bureau, but last year there were about 3,000 voluntary observers, making daily readings of standard government instruments, the daily observations being collected and printed in tabular form at 42 State centers. There are now 253 stations on our sea coast and the Great Lakes where storm signals are displayed, against 41 in 1883. In view of this remarkable showing, it is little wonder that Willis L. Moore, chief of the Weather Bureau, states in his Annual Report that, to meet the public demands, all workers have been taxed to the limit of physical and mental endurance. It is to be hoped that the increase of $160,348 will be granted, as it is urgently needed.

The work of the bureau during the last fiscal year was conducted on lines tested and approved by the experience of former years. The usual forecasts of temperature, wind and weather were issued twice daily, as were also special warnings of cold waves, frost, severe storms and hurricanes, as occasion demanded. There were no violent storms of which timely notice was not given. The flood warnings issued by the bureau in connection with the disastrous floods that occurred in the lower Mississippi Valley in the spring of 1897 were most timely and effective, and on March 15, two weeks before the first serious break in the levees occurred, it was announced in a special bulletin. The local officials, under instructions from the central office, gave the widest possible distribution to these warnings by mail and telegraph throughout the threatened regions. A daily bulletin was given to the press, thus keeping the public informed of the extent of the flood. It would be impossible to estimate the value of live stock and movable property saved by these warnings.

In hydrography the work has been no less efficient. There have been maintained through the year 113 river and 42 rainfall stations, making daily observations and full monthly reports, together with such telegraphic reports as seemed advisable for the purpose of weather forecasting. Beginning with the issue of the Monthly Weather Review for 1896, there has been included in that publication a monthly report on the condition of the rivers of the United States. The river service is composed of twenty-two sections, each with a central office receiving reports from a definite area, and each making local forecasts for the river districts under its supervision. In the case of impending disaster the central office at Washington dictates the important warnings for distribution by the section centers.

The year was somewhat remarkable for the absence of severe cold waves and destructive frosts, for such as occurred were, as a rule, accurately forecast in good season. The system of recording the advents of cold waves from station to station was put in operation during the year over the eastern Rocky Mountain slope from Nebraska to Texas. Gratifying success attended

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the warnings issued for the benefit of the fruit industry of Florida, the sugar interest of Louisiana and the truck-growing districts of the Eastern seaboard. The rain warnings from the San Francisco office for the benefit of the raisin district, during the drying season, were very successful. During the last three years not a single rain occurred in the raisin-drying region without a warning, and in only one instance was an unnecessary warning issued. The distribution of forecasts and warnings has been continued on practically the same lines as in former years. The climatic work of the Weather Bureau was very valuable, the statistics being collected concerning cotton, corn and wheat. The publications of the bureau show the usual care which is bestowed upon all government publications. The scope of the Monthly Weather Review has been enlarged and its usefulness increased through the untiring efforts of its editor, Professor Cleveland Abbe. It should be noted that Professor Abbe was one of the most active of those who thirty years ago advocated a government weather service. The scientific meteorological work of the Weather Bureau has been important as usual, and the results obtained with kites have been discussed in detail in a series of articles published in the Monthly Weather Review. The international simultaneous cloud observations were concluded on June 30, 1897. About 7,000 observations for cloud heights and probably 2,000 pairs of observations for direction and velocity were obtained at the primary station in Washington. Altogether, the report shows that this bureau of the government is well and economically administered, both from a utilitarian and scientific point of view.

ARTIFICIAL FLIGHT.

The fact that so many gifted scientists and engineers are engaged on the problem of artificial flight affords, in itself, a strong presumption that sooner or later a successful motor-driven flying machine will be an accomplished fact. It is only in recent years that the question of artificial flight has been recognized as deserving a high place among the many unsolved problems which are worthy of the serious efforts of the scientist and mechanic. It was not so long ago that the flying machine was classed as a kind of first cousin to the perpetual motion device, and the mere suggestion that anyone was attempting to fly caused a smile of pitying contempt.

The early experimenter, with his flapping wings, his curious and cumbrous mechanisms, and his manifold misconceptions of the fundamental laws of flight, has given place to a notable array of talent in the person of such men as Maxim, Chanute, Langley, Lilienthal and Hargrave. In their hands the problem has been attacked from the scientific and mechanical standpoints. The laws of flight have been determined by years of such successful investigation that to-day aeronautics may be classed among the exact sciences; and the mechanical difficulties, on the other hand, have been so far mastered that the world is only waiting for a sufficiently light and powerful motor to see a practical flying machine as much an accomplished fact as the pneumatic bicycle.

We publish in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT a remarkable paper by Octave Chanute, the distinguished engineer and scientist, which gives the results of his own exhaustive experiments of the last few years to determine the principles of flight. It is impossible to review this valuable paper at any length, and it will be sufficient to enumerate the various elements of the problem which are mentioned by Mr. Chanute as having each to be solved separately and the results combined in the successful machine of the future. The elements to be determined are as follows: The supporting power and resistance of the air; the motor, its character and energy; the instrument for obtaining propulsion; the form and kind of the apparatus; the extent of the sustaining surfaces; the material and texture of the apparatus; the maintenance of equilibrium; the guidance in any desired direction; the starting up under all conditions; the alighting safely anywhere. The seventh element, that of equilibrium, is the one which Mr. Chanute has successfully solved.

In December, 1895, Mr. Chanute secured the services of Mr. A. M. Herring, a civil and mechanical engineer, and together they carried out a lengthy series of experiments in "gliding," with the purpose of solving the problem of equilibrium. This he has successfully accomplished by reversing the method of Lilienthal, who moved his body to bring the center of gravity under the ever-shifting center of pressure of the machine. Mr. Chanute provided mechanism within the machine which shifted the supporting planes over the center of gravity of the operator, and the results have been highly gratifying. The paper is accompanied with a large number of illustrations made from snapshot photographs taken during flight, and they show that the problem of equilibrium—perhaps the most essential of all—has been successfully solved. It was the failure of Lilienthal's device to maintain equilibrium, it will be remembered, that caused his death, the machine pitching suddenly forward and throwing him head first to the ground.

EDISON ON PATENTS.

Thomas A. Edison has taken out probably more patents, says The New York Sun, than any other inventor. He owes his fortune and his fame to some of them; he has lost greater fortune and perhaps greater fame because he was not able to protect his rights in others. Naturally his knowledge of patent practice is extended, and when he talks of invention as a profession he speaks by the card.

"The value of a patent," says the inventor, "diminishes in the ratio at which the value of the thing patented decreases. That is to say, if a man gets up a patent on a wrench, that patent has a real value and may be profitable; but if he gets up a patent on a system which revolutionizes things and is of tremendous value to the world at large, that patent is not valuable to the inventor, on account of the procedure of the court.

"In a great many cases, outside of mechanical things, the trade secret is more valued as a protection than a patent. Dishonest persons often can get the inner track of an important discovery or patent, and make use of it illegally, while the inventor may never realize anything on his work, although he may spend thousands of dollars and continue the fight for years. Yes, the value to the inventor of a patent increases just as its value to the public decreases; the reward for his services increases with the lack of value of the patent. There is less reward than ever for the industrious inventor.

"One of my biggest inventions, for which patents were asked years ago, has just been declared mine by law. Meantime other men have been and are using it and are deriving the financial benefit, all on account of the workings of the patent system. Of course, I can sue them, but it will be a long time before I can do anything. In short, there is comparatively little reward for the inventor of the important machine. A trade secret is of value in the chemical line, for there it can be guarded. For instance, in the case of Bessemer of Bessemer steel fame. He made his money by making bronze powder by a secret process, and kept the secret in the family for years before it was finally given out to the world. As with the small patent, the small trade secret has the advantage in holding the market and in keeping the device from being stolen. Get up trivial inventions of minor importance and they are valuable.

"Infringers of patents take advantage of the practice of the United States Supreme Court. If you get out a patent which is likely to become valuable to the public at large, you will find that it will sooner or later be infringed upon. If it were possible to get an injunction immediately against an infringer all would be well, but you cannot do this. When you start up, the other fellow sails right in and begins manufacturing and selling just as you do, and generally at a lower price. You cannot do anything in court for five or six years, and the infringer knows this. After having spent a large amount of money and time in inventing your patent, you place the price of it to the public at a figure which will, you think, reimburse you for your expenditure. The infringer does not have to meet any of these exenditures, and can therefore afford to sell far below your price. A lawsuit for you is a costly matter; for him it is comparatively a trifle. For instance, in order to prove your patents you have got to make researches, you have got to have expert drawings made, and there are numberless other expenses which eat up profits. All the infringer has to do is to employ a lawyer who is noted for causing delays in court. Every time your case comes up he attempts to delay it, and generally succeeds. Meantime, you are manufacturing at a loss, while the infringer is manufacturing at a profit.

"If after five or six years you prove to the court that you are rightfully entitled to the invention, there is but one thing left to you—to attack your opponent's factory. At this point you will awake to the fact that he has no factory. You will find that the machinery has been rented, or else it is in the name of his wife, or that he has an irresponsible company made up of his employes or of his family, and when finally you swoop down upon him all you can find in his office is a desk and a chair. He can still run the shop machinery and give more trouble, and in the end there is not only no reward for the inventor, but absolute loss. It takes time to pioneer all new things. After you talk to the public, other people see that you have a good thing and organize irresponsible factories. You have, perhaps, spent $100,000 for machinery, tools, etc., then along comes the other fellow, without any responsibility, and makes all the money he can before you are able to get judgment against him.

"The laws are all right and don't need revision. It is not the laws. The Patent Office is all right, too. There is no corruption there. It all lies with the power and practice of the United States Supreme Court. Years ago they would grant an injunction on the face of the patent. The patentee had better rights. Now they don't, and that is what is driving every good man out of the business, or driving him into details, because they are safe. If you get up a wrench, there is not the danger of another man coming in and spending $200,000 or $300,000 fighting you on a thing which don't pay you $5,000.

"The operations of patent sharks sometimes compel an inventor to obtain patents for articles which are never meant to be placed on the market. A fellow often gets up a machine, and somebody else comes along, and by getting patents through for certain parts, can give the inventor a great deal of bother and make him pay well, even if the inventor gets control of it. A man ought to patent every part of his machine which he intends to use, so that he will have a bona fide claim to use it and cannot be infringed by other inventors. The inventor should first patent the principal parts and improvements, then patent the variations and completed model, to protect himself in the courts of law. In short, as I said before, the value of a patent to an inventor is directly decreased as the value to the public increases. The practice of the United States Circuit Court is such as to drive all the inventors away from revolutionizing inventions into little details."

THE SMITHSONIAN INSTITUTION, 1846-1896.

We have received from the Smithsonian Institution a handsome quarto volume, entitled "The Smithsonian Institution, 1846-1896." The history of its first half century, edited by the late George Brown Goode. This beautiful volume, which issues from the De Vinne Press, has 856 pages, and is illustrated with engravings of the founder, secretaries and the regents of the institution as well as views of buildings, etc. The text is largely from the pen of the late George Brown Goode, and Messrs. Samuel Pierpont Langley, Cyrus Adler, W. J. McGee, W. C. Winlock, Frank Baker, F. William True and David Starr Jordan. The chapters take up the history of the Smithsonian Institution, giving a biography of James Smithson, followed by an account of the "Founding of the Institution," the "Establishment and the Board of Regents," "The Three Secretaries," "The Benefactors," "The Smithsonian Buildings and Grounds," "The Smithsonian Library," "The United States National Museum," "The Bureau of American Ethnology," "The International Exchange System," "The Astro-Physical Observatory," "The Zoological Park," "The Work of the Smithsonian Institution," "Smithsonian Publications," and a "Biographical Sketch of George Brown Goode." This matter occupies some 500 of the 800 pages, and is filled with important information on the history of the development of science in America. None of these chapters is more interesting than that which is given up to the three secretaries. It will certainly be hard to find three greater men in their respective lines than Joseph Henry, Spencer Fullerton Baird, Samuel Pierpont Langley. Then follows a review of the work of the Smithsonian Institution by such men as T. C. Mendenhall, R. S. Woodward, E. S. Holden, Ed. Drinker Cope, Theodore Gill, the late Gardner Greene Hubbard, H. Carrington Bolton, D. C. Gilman, J. W. Fewkes, Marcus Benjamin, W. G. Farlow, W. N. Rice, John Shaw Billings and A. R. Spofford. This splendid work is completed with an appendix, which gives important events in the history of the institution, compiled by W. J. Rhees. It is not surprising, after examining this book and seeing what this institution, the result of the bequest of a single man, has done to give American science its position in the world, that foreign governments should desire the same kind of an institution for their own countries.

RECOVERY OF SILVER FROM FIXING BATHS.

Mr. Randolph Bolling writes us from the chemical laboratory of the University of Virginia, Charlottesville, Va., in regard to a new method of recovering silver from fixing baths. He states that, having had occasion recently to make an analysis of photographic fixing baths, to determine the amount of silver present in combination with the sodium thio-sulphate, the unoxidized silver salts on the developed plate were dissolved in a solution of thio-sulphate to form a salt having the formula $NaAgS_2O_3$. The silver was first precipitated by ammonium sulphide, and it came down as black sulphide of silver. This was then separated by filtration from the liquid, and, after being washed three times in hot water, was dried and heated on charcoal. The reaction which took place was as follows:

$$Ag_2S + O_2 = SO_2 + Ag_2.$$

The silver was then melted by a blowpipe, and finally it was weighed. Mr. Bolling obtained the following results:

Silver from the fixing solution of two developed 5×7 dry plates 0·2769 milligramme.

Silver from the fixing solution of two developed $3\frac{7}{8} \times 5\frac{1}{2}$ dry plates 0·2051 milligramme.

As the last plate mentioned is of the standard cabinet size, the analysis may be of some value to photographers. The results are certainly very interesting from a scientific and practical point of view.

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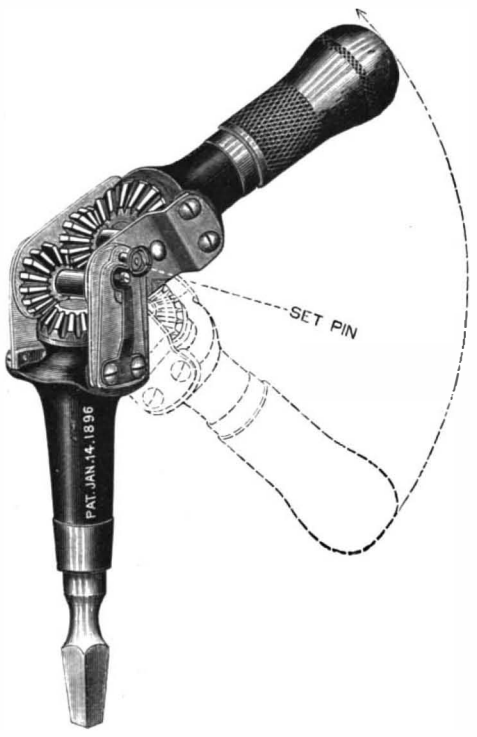
AN ANGULAR BIT STOCK.

An extremely convenient form of holder for a chuck or head for small drills or other boring tools, enabling the drill to be placed and locked at any angle to the shank of the holder, or the stem communicating power to the drill, is shown in the accompanying illustration. The device has been patented and is manufactured by C. A. Meister, of No. 726 Union Street, Allentown, Pennsylvania. The device comprises pivotally connected frame sections, one section consisting of a sleeve having a fork at one of its ends, and the other section having side pieces, a transverse shaft pivotally connecting the side pieces of one section with the fork of the other section. This shaft has a gear wheel meshing with a bevel gear on a driving shaft in the sleeve of the forked section, whereby motion is communicated to an intermediate and a bevel gear of the tool-carrying section. By means of a set pin, shown in the illustration, the tool-carrying chuck may be carried around, as indicated by the dotted lines, and set and locked at any desired angle to the bit brace. The gear attached to the chuck is 1½ inches in diameter, while the other gears are only 1 inch, giving more power to the bit than if the gears were all of one size.



MEISTER'S ANGULAR BIT STOCK.

Food Lost in Cooking.

Experts connected with the experiment stations of the United States Department of Agriculture have been making some interesting tests showing the losses in the boiling of vegetables and the composition and digestibility of potatoes and eggs, says The New York Sun. A. C. True, director of these experiment stations, remarks that, although the greater part of the food of man is prepared for use by cooking, yet the changes which various foods undergo during the process and the losses which are brought about by cooking have been little studied. Prof. H. Snyder, Dr. Almah J. Frisby and Dr. A. P. Bryant have just completed some investigations on the loss of nutrients in boiling potatoes, carrots and cabbages; also on the composition and digestibility of potatoes and eggs.

Few persons know that in 100 pounds of uncooked cabbage there are but 7½ pounds of dry matter, and of this dry matter from 2¼ to 3 pounds are lost in the process of cooking. This loss seems to be unavoidable, unless the cabbage is cooked in such a manner that the water in which it is boiled is also used. This is frequently the case when cabbage is cooked with corned beef. In the experiments made at the government stations, potatoes, carrots and cabbages were selected as being the best representatives of tubers, roots and pot herbs.

The conclusions drawn from the experiments with potatoes are substantially as follows: First.—In order to obtain the highest food value, potatoes should not be peeled before cooking. Second.—When the potatoes are peeled before cooking, the least loss is sustained by putting them directly into hot water and boiling as rapidly as possible. Even then the loss is very considerable. Third.—If potatoes are peeled and soaked in cold water before boiling, the loss of nutrients is very great, being one-fourth of all the albuminoid matter. In a bushel of potatoes the loss would be equivalent to a pound of sirloin steak.

Although carrots contain less nitrogen than potatoes, they are found to contain relatively more albuminoid nitrogen, and therefore to furnish more matter available for building muscular tissue. From the experiments with carrots the following conclusions are deduced: In order to retain the greatest amount of nutrients in the cooking of carrots, the pieces should be large rather than small; the boiling should be rapid, in order to give less time for the solvent action of the water to act upon the food ingredients; as little water as possible should be used, and if the matter extracted be used as food along with the carrots, instead of being thrown away, the loss of 20 to 30 per cent or even more of the total food value may be prevented.

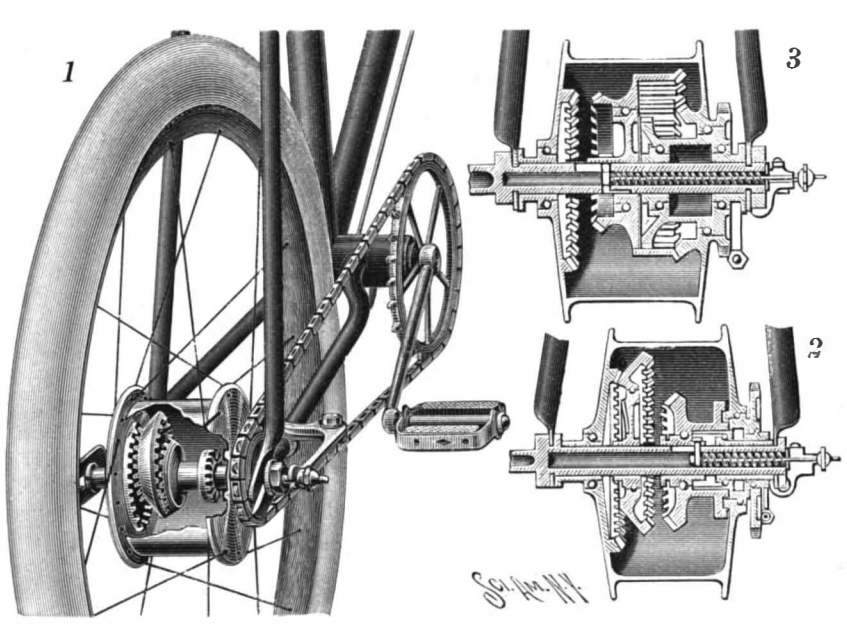
Experiments analogous to those with potatoes and carrots were made with cabbages, to determine the loss of food material during the process of preparation for the table. Cabbages represent the class of pot herbs in which the leaves are the edible portion. They expose more surface to the action of the water than do tubers or roots. The kind of water used has more effect on the loss of nutrients in cooking cabbage than the temperature of the water at which the cooking is started. In any case the loss is large.

The purpose of these experiments just completed is to learn what actually takes place in the process of preparing food by the common methods. The losses which occur in the cooking of potatoes, carrots and cabbages vary with the different methods of boiling followed. While the net loss is not so great as to render it imperative that people in comfortable circumstances should abandon methods of preparing these foods which they consider make them most palatable, there are believed to be many persons who cannot afford to permit even the comparatively small waste of food observed in these experiments.

In the tests with eggs, it was shown that, while the method of cooking has some effect upon the rate of digestibility, it does not materially affect the total digestibility. Rubner, in an experiment with man, found that 79·1 per cent of the nitrogen of hard-boiled eggs was digested.

AN IMPROVED DIFFERENTIAL BICYCLE GEAR.

The accompanying illustration represents improvements in bicycle gear designed to allow a rider to readily and conveniently change from a low gear to a high gear, and vice versa, the construction being strong, simple and comparatively inexpensive, and the arrangement being such that the friction is reduced to a minimum. Figs. 1 and 2 show the invention as most recently improved, and Fig. 3 represents the gear according to a patent granted some weeks ago, the inventor being Mr. Guy R. Balloch, of Centerville, New Brunswick, Canada. As represented in Fig. 3, the hollow hub of the drivewheel turns at its sides on ball bearings, one bearing being supported from a hollow axle and the other being carried by the sprocket wheel supported from the hollow axle, so that the hub and the sprocket wheel turn independently of one another. On the inner faces of the sides of the hub are bevel gear wheels of different diameters, adapted to be alternately engaged by two inner gear wheels, forming a double gear rotating on ball bearings on a disk eccentric to the hollow axle. The double gear wheel is adapted to slide laterally in the hub and is rotated from the sprocket wheel. The lateral movement of the double gear wheel, to engage either of the hub differential gears, is effected by means of a spring-pressed hand lever extending under the handle bar, in convenient reach of the rider, and by means of a high and low gear can be made use of whenever desired. The entire device is completely inclosed within the hollow hub, and hence is thoroughly protected from dust and is not liable to get out of order. According to the improvement represented in Figs. 1 and 2, the hollow drive wheel hub is provided with a gear wheel and clutch teeth, a gear wheel being mounted to turn with and held to slide on the hub of the sprocket wheel, the slidable gear wheel being provided with clutch wheel for engagement with the hub clutch teeth. There is a double gear wheel eccentric to the slidable gear wheel and the hub gear wheel, one of the gear wheels of the double gear wheel being in mesh with the hub gear wheel, and the other gear wheel of the double gear wheel being adapted to be engaged by the slidable gear wheel at the time the clutch teeth of the latter are out of mesh with the hub clutch teeth. The entire device is completely inclosed within the hollow hub, and the change of gear is similarly effected by a lever extending up under the handle bar.



BALLOCH'S DIFFERENTIAL BICYCLE GEAR.

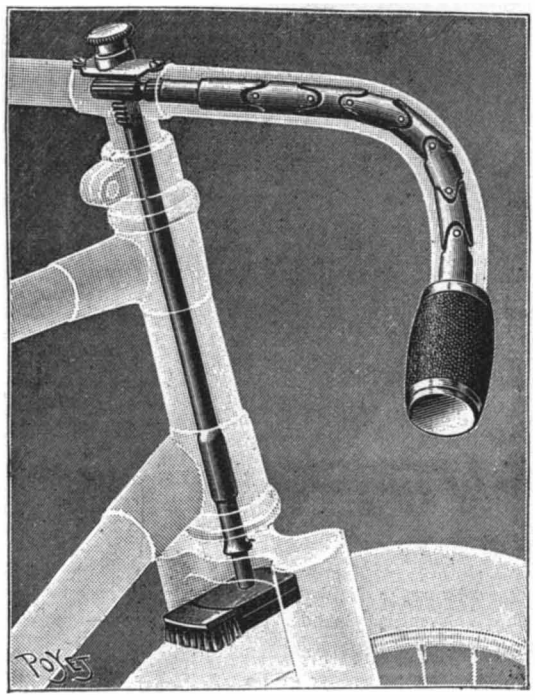
PREVENTIVE medicine as a science has wholly arisen during the reign of Queen Victoria, says The Independent, and it is a curious fact that the only sanitary law on the statute book—the Quarantine Act of 1825—was, on the eve of the Diamond Jubilee, erased from the statute book as a vexatious measure no longer to be tolerated. The first step in modern sanitation was the registration of vital statistics, which began in the first year of Victoria.

AN INVISIBLE BRAKE FOR BICYCLES.

All tourists' bicycles are not provided with a brake, although all ought to possess one, even though it might have to be used only on very rare occasions. One of the reasons (a bad but strong one, like all bad reasons) for the disfavor in which the brake is held by a large number of bicyclists is that it spoils the appearance of the machine. As an answer to this, it might be said that safety should be considered before elegance; but to make such an assertion would be a waste of time. Another fault found with the brake (chiefly by women) is that, in a lengthy descent, the necessity of holding it tightly tires the right hand.

A brake that was invisible and that kept up the desired degree of friction indefinitely would, therefore, prove welcome by setting at naught the two principal objections that we have just formulated.

Such a brake has been in existence for the last two years. It was devised by an Englishman, Mr. Alfred Williams, and a representation of it is given in the accompanying figure.



INVISIBLE BRAKE FOR BICYCLES.

The block of this brake, which is concealed beneath the crown of the fork, is mounted upon a rod, which is itself concealed in the steering head. This rod terminates above in a rack, with which engages a small pinion that may be revolved in one direction or the other by turning the right hand grip. The transmission of the revolution of the grip to the pinion is effected through the intermedium of a series of joints arranged in the interior of the right hand branch of the handle bar. The friction of all these joints in the handle bar is sufficient to keep the pinion firmly in place in the position that is transmitted to it in acting upon the grip. In this way, owing to such ingenious arrangement, there is obtained an invisible brake, which may be tightened to the desired degree at will through a slight turn of the grip without any fatigue to the bicyclist. A slight turn in the opposite direction at once loosens the brake either partially or totally.

The brush with which the brake block is provided has the effect of cleaning the pneumatic tire before it comes into contact with the rubbing part, thus sensibly reducing the wear of the tire.

We are indebted to La Nature for cuts and copy.

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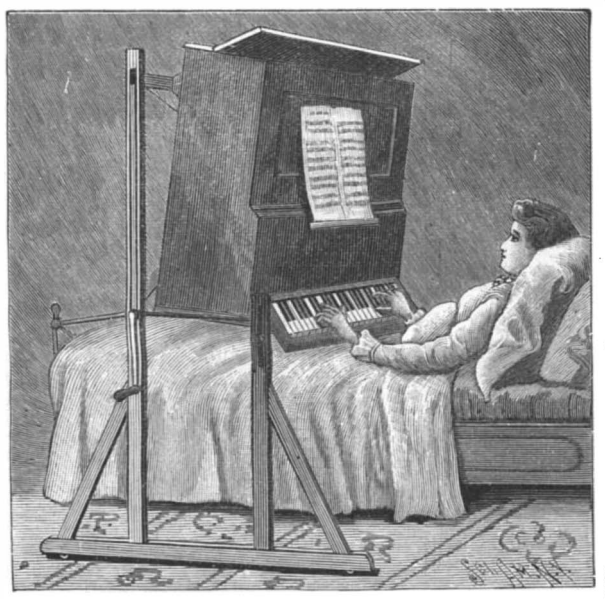
A PIANO FOR INVALIDS.

One of the things which physicians have to contend with is the lack of occupation for the convalescent. The case may be a surgical one, leaving the faculties perfectly unclouded, yet the patient must lie for days upon the bed with no other amusement than reading or conversation.

We illustrate a piano for invalids which will be a boon to many a sick musician. On each side of the bed are the uprights of a frame, the base being mounted on casters. This frame supports a small upright piano. Adjusting devices are provided which will enable the piano to be firmly secured in any desired position. The keyboard is inclined so that the keys may be easily reached by the sick person. Of course, such a piano would almost necessarily be a luxury for the rich, but there seems to be no good reason why it should not be rented for cases of temporary illness and in some private sanitariums, where the music would not be disagreeable to the other inmates.



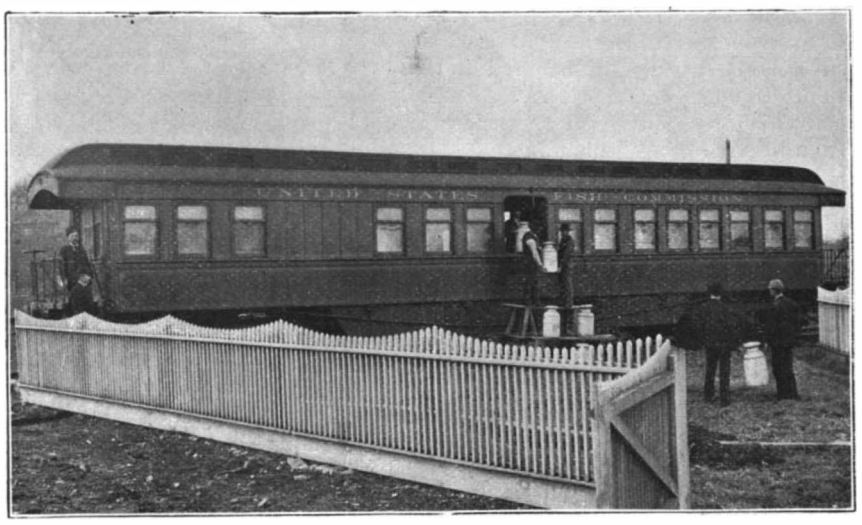
A PIANO FOR INVALIDS.

This instrument has been put upon the market in England, but we believe that it has not yet been introduced into this country.

THE TRANSPORTATION BY RAIL OF FISH AND FISH EGGS.

The United States Commission of Fish and Fisheries have just published an interesting work entitled "A Manual of Fish Culture, Based on the Methods of the United States Commission of Fish and Fisheries, with Chapters on the Cultivation of Oysters and Frogs." By kind permission we are enabled to present some engravings of the United States Fish Commission car.

The work of the United States Commission of Fish and Fisheries is carried on at twenty-five stations or hatcheries located at suitable places throughout the country. At Wood's Hole and Gloucester, Massachusetts, cod, mackerel, lobster and other important marine species are propagated and the fry are deposited on the natural spawning grounds along the coast. At Battle Creek, Baird and Hoopa Valley in California, at Clackamas in Oregon and Little White Salmon River, Washington, the eggs of the Pacific salmon are collected and hatched, and the fry are planted on the spawning-beds in the neighboring streams. The Atlantic and land-locked salmons are cultivated in Maine at Craig Brook and Green Lake to restock the depleted streams and lakes of New England and northern New York. On the Great Lakes, at Cape Vincent, New York; Put-in Bay, Ohio; Alpena, Michigan; and Duluth, Minnesota, the work is with whitefish and lake trout, in order to sustain the great commercial fisheries conducted for those species. Hatcheries in the interior at St. Johnsbury, Vermont; Wytheville, Virginia; Northville, Michigan; Manchester, Iowa; Bozeman, Montana; Neosho, Missouri; Quincy, Illinois; San Marcos, Texas; and Leadville, Colorado, are devoted to the important work of maintaining in the inland lakes and streams the supply of brook trout, rainbow trout, black bass, crappie and other fishes. During the spring, on the Potomac, Delaware, and Susquehanna rivers, shad are hatched and are distributed in suitable streams along the Atlantic coast. For the distribution of fish and eggs the commission has four cars specially equipped with tanks, air-circulating apparatus and other appliances.



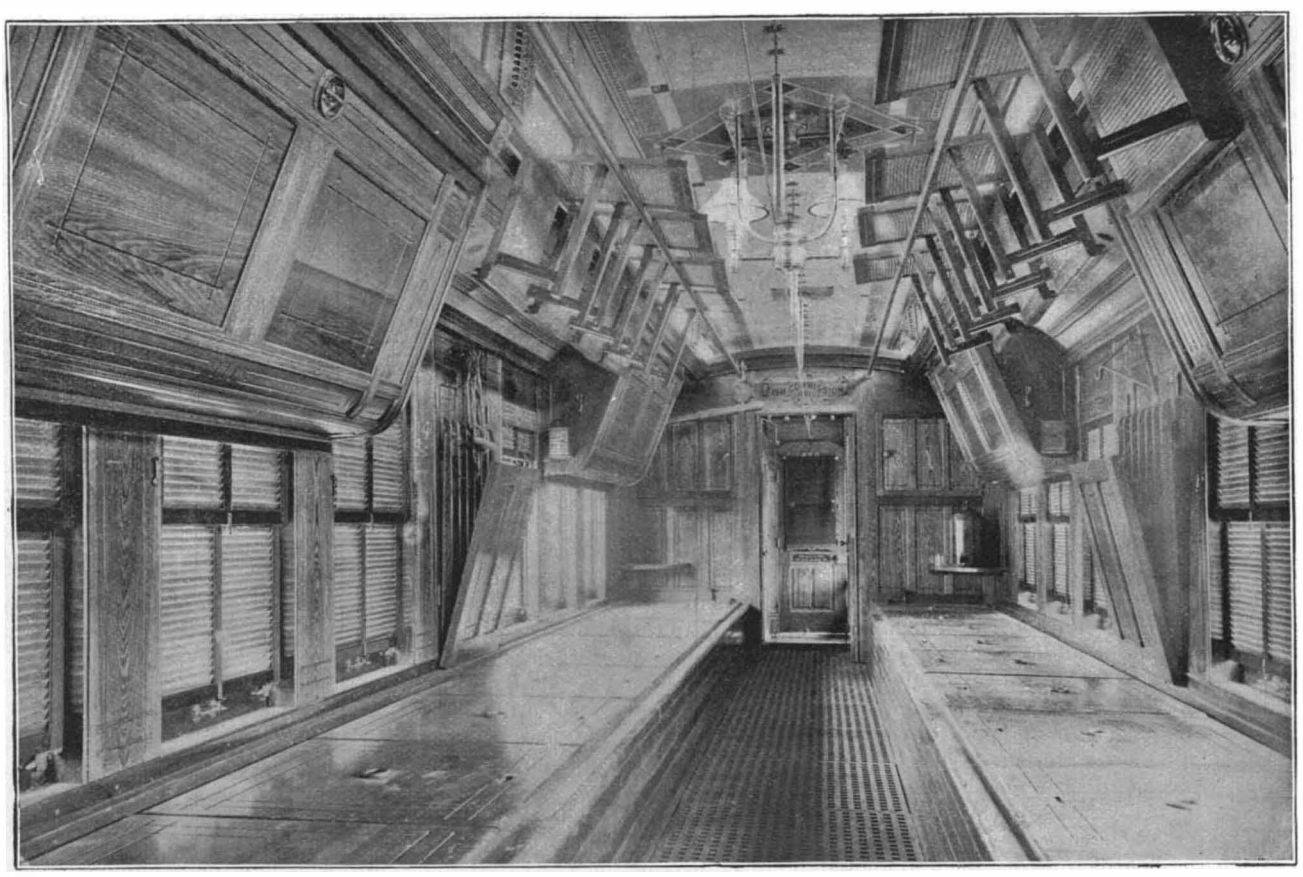
UNITED STATES FISH COMMISSION CAR LOADING AT NEOSHO, MISSOURI.

During the earlier years of the Commission young fish were carried by messengers in baggage cars on regular passenger trains, but as the work increased it was found that this method was inadequate and other arrangements must be made to transport the large number of fish which were being hatched. Accordingly, in 1879-80, experiments were successfully made in moving shad fry in specially equipped baggage cars, and it was found that large numbers of fish could be economically moved with little loss. A car was then constructed specially adapted for the distribution of live fishes, the requirements of such a car being a compartment for carrying the fish in which an even temperature could be maintained. Proper circulation of air and water in the vessels containing the fish and sleeping and living accommodations for the messenger attending them were also provided. A baggage car which was 51 feet long, 9 feet 10 inches wide, and 13 feet 8 inches high was purchased. At one end of the car was a room, containing a stove, sink and berth for the use of the cook, besides a boiler, pump, etc., and at the other end were two sections of berths like those in a Pullman car, which would accommodate two men at each side.

Each compartment was about 7 feet long. In its center was a refrigerator compartment 30 feet 3 inches long, extending up to the clear story. The ice was carried in racks holding one ton each, which were located in the corners of the refrigerator diagonally opposite each other. Cylinder cans placed on galvanized iron tanks, 9 feet 4 inches long, 28 inches wide and 8 inches high, were provided in which to carry the fish. The tanks were placed on opposite sides of the car, with a passageway between them. An apparatus for circulating water was arranged, a long semicircular iron tank being carried on the roof. From this the water was brought into a 6-inch pipe extending all around the refrigerator compartment. The pipe contained a sufficient number of pet-cocks to supply the number of cans carried, the water being conveyed to the cans through rubber tubing. From the cans it passed into tanks through the same size tubing, which was turned into 2-inch pipes underneath the car, and from these pipes was pumped up to the tank in the clear story. This circulating apparatus worked well, but this arrangement necessitated carrying a large amount of water in the top of the car, thus causing it to roll from side to side in such a manner as to make it unsafe. Another car was built to remedy this and other defects.

The Commission now has four transportation cars in use. They differ somewhat in construction, and the car known as No. 2 is regarded as the best type. It is equipped with six-wheel Pullman trucks, paper wheels, combination couplers, etc., so that it can be hauled on passenger trains. Underneath, between the trucks, are boxes for carrying provisions, tools, etc., and a water tank. Inside, the car is finished in white ash, and due arrangements are made for the comfort and convenience of the crew. At one end is an office for the use of the captain and at the other end is the kitchen and the 5-horse power boiler, steam pump and air pump.

The fish are carried in tanks or cans arranged into refrigerating compartments each side of the passageway. These compartments have two upper berths at each side for the accommodation of the crew. The refrigerating chambers are 26 inches high, 34 inches wide, and are provided with lids; the partitions are filled with cork, which is used on account of its non-conducting properties. At one end of the chambers is an ice-box which holds about three-fourths of a ton of ice. The transportation tanks used in carrying yearling and adult fishes are made of heavy galvanized iron, and are 27 inches long, 27 inches wide and 24 inches deep, holding 52 gallons each. They are heavily coated with asphalt before being used. For the transportation of fry ordinary 10-gallon iron cans of tin are used. The supply of water is carried in an iron pressure tank of 500-gallon capacity which is located in the body of the car next to the office. The water is circulated by a steam pump through galvanized iron piping which runs from the pump to the pressure tank, thence along the sides of the refrigerator to the transportation tanks, whence it flows by gravity to a tank below the floor, from where it is pumped into the supply tank for distribution. In order to provide sufficient air circulation, the air is driven by a pump to a 30-gallon reservoir in the top of the car, over the boiler room, from which it is taken to the transportation tanks or cans through two lines of iron piping running along the sides and top of the car. One pet-cock is placed in the pipe for each tank to be supplied with air, which comes to it through a hole $\frac{1}{32}$ of an inch in diameter. From the pet-cock the air is carried into the tank with rubber hose and released in the water through liberators made of American linden placed in hard rubber holders. This car is also fitted with a hatching outfit. Our engravings show the exterior of the car and the interior, with berths and chairs which hang up so that the compartments can be opened.



INTERIOR OF FISH TRANSPORTATION CAR SHOWING BERTHS AND CHAIRS.

TRAFFIC on the railroad between Tientsin and Pekin has increased so much that a double track must be laid at once.

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THE SUBMARINE WRECKING-BOAT "ARGONAUT."

The public is familiar with the ordinary methods adopted in carrying out diving operations, and there are probably few of our readers who have not at some time seen a diver in his bulky dress and grotesque headpiece climb slowly down the ladder and disappear beneath the surface, dragging his signal lines and air-supplying hose after him. When subaqueous work is being done adjacent to piers or docks, the air-pumps, tools and various machinery are located on the pier or dock; if the operations are being carried out at a distance from the shore, the plant is carried on a scow or suitable boat which is anchored in the desired position. In both cases there is a measure of delay and inconvenience arising from the separation of the diver from his assistants, which increases in proportion to the depth at which the diving operations are being carried on. Moreover, when the work is being carried out in the sea or in broad expanses of water, where the surface is liable to be disturbed by stormy weather, work can only be done when the surface is practically calm. There is a further delay due to the time lost by the diver in coming to the surface to give directions, to rest, or to secure what tools he may require from time to time.

The most serious drawback, of course, to diving operations, when they occur in open water, is the limited time during which they can be carried on. This is felt most severely in the salvage of sunken ships and in the submarine foundations of piers, lighthouses and similar classes of work. The difficulty occurs, not with the diver, who is usually working at depths which are never disturbed by the surface waves, but in the working platform, the scows, tug boats, etc., above him.

Our accompanying illustrations show the construction and operation of a submarine wrecking-boat which has been designed to overcome these difficulties and enable the whole of the outfit, including divers' quarters and the air-compressing plant, tools, winches, etc., to be placed at the bottom of the ocean in close proximity to a wreck. The many advantages of such a device, if it can be successfully operated, are obvious, and the details of the design, as worked out by Mr. Simon Lake, of Baltimore, Md., are certainly full of interest. A wrecking-boat containing a full staff of divers and all the necessary machinery and tools for their work, which is capable of proceeding to the scene of a wreck "under its own steam" and sinking to a good working position alongside the sunken ship, where operations can be carried on uninterruptedly, would be a valuable acquisition in salvage operations.

It is claimed by the builders that the boat would be capable of locomotion over the floor of the ocean, and that this feature renders it particularly valuable in the location of a sunken ship. For this purpose, as will be explained later, it is provided with a pair of wheels near the bow and a caster steering wheel at the stern. We do not think that this feature will be practicable except under the ideal conditions of a smooth and hard floor. On a rocky or uneven bottom, or a bottom of extremely soft mud, locomotion would be manifestly impossible. On the other hand, it is but fair to mention that only a small proportion of the dead weight of the boat will rest upon the bottom, the water ballast being so regulated that the buoyancy of the boat will insure only a small weight upon the wheels.

The hull of the boat, which is approximately cigar-shaped, is 36 feet long by 9 feet in diameter, and the submerged displacement is 57 tons. It is strongly built to resist water pressure at depths up to 150 feet. The plating is laid over angle iron frames measuring 3 ins. by 3½ ins. by ½ inch. The hull is divided by transverse diaphragms into four compartments—the engine and living room, the air lock, the divers' room and the look-out compartment. The engine and living room is the largest compartment and occupies about two-thirds of the length. The after part of it is occupied by a gasoline engine and a dynamo which drive the same propeller shaft. The gasoline engine is used when the boat is traveling at the surface and the dynamo may be disconnected from the engine and used as a motor when the boat is submerged. Two sets of storage batteries are located in lockers at the sides of the boat. These are charged by means of the engine and dynamo, the coupling between the latter and the propeller shaft being released for this purpose. In cases where the bottom is judged suitable for locomotion, it is proposed to lower the boat until the ribbed wheels rest upon the bottom with sufficient pressure for traction and propel it by means of the forward motor, which is shown geared to the axle of the forward wheels.

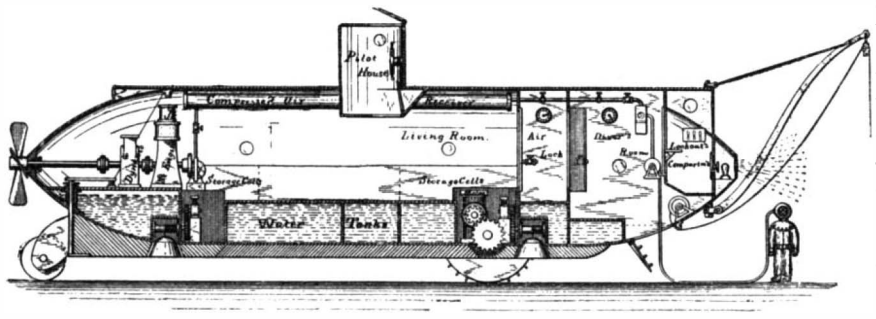
The living room furnishes accommodation for six men. It is provided with an air compressor and storage tanks, the latter placed as shown in the diagram near the roof, which serve to renew the air vitiated by the crew and also to supply the divers when they are at work outside the vessel. When the boat is working at moderate depths, as shown in our illustrations, air is supplied through two air-pipe masts, which also serve to show the location of the boat and the direction in which it is traveling. At greater depths the pipe masts are closed and air is drawn in through a suction hose connected to a float on the surface. For the greatest depths the hose can be discarded altogether, and dependence placed upon the air storage tanks. These are of sufficient capacity to supply the crew for a period of 48 hours. There is an advantage of course in the use of the pipes or hose in the fact that the boat may remain submerged for an indefinite period of time.

The compartment forward of the living room is an air lock and is used for giving admission to the divers' room. Although the air pressure in the living room is about normal, that in the divers' room is always maintained at the pressure of the water at the depth at which the boat is working. When a diver leaves the boat to work upon a wreck the operation is as follows: He first enters the air lock, and the pressure is raised to that of the divers' room. He then enters the divers' room and opens a door in the floor of the room through which he passes out on to the river or ocean bottom, as the case may be. It will be understood that no water can enter the divers' compartment because of the air pressure within it.

The divers' room contains a telephone, hose reel, hoisting engine and all the various tools made use of in wrecking operations. It is practically a divers' workshop with everything provided ready to hand—and instead of his being separated from his assistants he is in close touch with them all the time he is at work.

The forward compartment is practically the pilot house when the boat is submerged. The steering and control of the boat are managed from this position, as is the hoisting derrick which is used in transferring cargo from the hold of a sunken vessel. These operations are assisted by a powerful search light, which sends a beam of light straight ahead or to either side of the boat. The air pressure in this compartment is normal.

When the boat is traveling at the surface of the water it is controlled from a central pilot house, which is provided with four bulls-eyes. Entrance is had to the boat through a trap door in the roof, which can be closed down so as to render the boat perfectly dry, even if the surface should be broken with waves.



6.—SECTIONAL VIEW OF SUBMARINE WRECKING-BOAT.

The proper trim and buoyancy of the boat is secured by means of a fixed keel extending over two-thirds of the length and a set of water tanks in the floor. Water is let into the tanks to sink the boat and blown out of them when it is desired to rise. To assist in keeping it stationary at any desired level, a pair of weighted anchors is provided. Normally, they are drawn up into pockets in the keel of the boat by means of two electric motors, as shown in the diagram, and when the boat is to be anchored at a desired level they are let down to the bottom, and the exact level of flotation attained by winding or unwinding the winches.

The smaller of our front page illustrations are made from photographs taken when the boat was under way, and show her being gradually sunk below the surface. The larger illustration represents it at work on a wreck in about 30 feet of water. In this case the fresh air for the use of the crew and the gasoline engine is being drawn in from the surface through the hollow masts.

Large Acetylene Explosion.

The works of the United States Liquefied Acetylene Distributing Company, on Montgomery Street, Jersey City, were wrecked December 24 by a series of explosions and destroyed by the fire which followed. Two men were killed and a number of persons were injured and there were many narrow escapes.

The United States Liquefied Acetylene Distributing Company is a comparatively new concern, which has been formed to supply liquefied acetylene gas to a number of companies in various parts of the country which are endeavoring to introduce the gas for lighting purposes. These companies are organized to work under the Willson calcium carbide patents and other patents which were taken out by Dr. Julius J. Suckert for the liquefying of the gas. At least one accident has happened before owing to the dangerous nature of the liquefied gas.

In the factory the calcium carbide was taken to the generator house, where, in proper receptacles, it was decomposed by the introduction of water. Through pipes it was then transmitted to the main building, where compound compressors, like those used for compressing air, reduced its volume until it was under a high pressure. While this operation was going on, the gas was cooled by refrigerated brine passing about the pipes which held it. Whatever water it held in suspension was extracted by passing it through suitable coils of pipe, and then it was led to the part of the room where it was to be turned into liquid and sealed up in the steel tubes. In this last process the steel tubes were immersed in a refrigerated bath, kept so cold that when the gas entered the tubes the low temperature and pressure upon the gas combined turned it into a liquid form.

This was the work that was going on at the time (9:30 A. M.) of the accident. It was the custom before filling a tube which had come back, presumably empty, to first let into it a small charge of gas and then to open a valve and let this gas escape into the room. This was to make sure that no air should be in the tube when it was finally charged. This operation was called "blowing off," and no lights, no smoking, no fire of any kind was permitted about the building except in the boiler room, and that was as separate as if it were in another building.

The cause of the accident has not been accurately determined; it is known that while one of the workmen was blowing off a tube there was a puff and a sheet of flame spread through the room. A moment later came the first explosion. It was not nearly as heavy as a number which came later, but it blew a 20-foot square hole in the side of the compressor room next to the railroad trestle. There was no sign of fire when outsiders reached the works after the first explosion, and it was ten or twelve minutes before the next one came. Then there began a series of explosions, small compared with the first. Perhaps there were a dozen of these, and then there was a tremendous one, which tore the whole factory to pieces and filled the air for blocks around with missiles. Many of these missiles were the steel tubes in which the gas was stored. There were about seventy-five of these already filled in the works. Each one is about the size of a six-inch shell, and of much the same shape, being three feet or more long and weighing about sixty pounds. One of these was shot across the street, where it tore a hole through the false front of the chain works and landed far in the rear of that building. The doors and windows of this building were blown in, great strips of clapboarding were torn out of the front and the office was wrecked. No one was at work there.

Right next door to the west of the works, Mr. Byrne recently erected a row of four-story frame tenement houses. These buildings have been occupied for about two months. There were twenty-four families in them. When the big explosion came, these houses rocked back and forth, plaster fell in great pieces from the walls and ceilings, and a moment later, when the air rushed back, the whole side of the building was torn loose from the floor beams and bulged out for more than a foot. On Fremont Street, just beyond the railroad trestle, were seven houses. These held thirty families. Windows, walls, and wainscoting were torn away in these houses as well. In a moment all was confusion in the neighborhood. Women ran from the houses, leaving the babes and the aged behind, all screaming and crying out for help. They were no sooner on the street than they encountered new terrors. From the wreckage fire was springing high, and every few moments there were other explosions, which sent great pieces of burning wood and torn metal work flying about. Police and firemen came and did what they could. The police forced the remaining people out of their houses, while the firemen attacked the flames. With the first water that the firemen turned on, they discovered that they were helpless against such a fire. The water found stores of calcium carbide in the ruins, decomposed it, set fire to the acetylene gas, and added to the fierceness of the fire. Acetylene burns with a flame many times hotter than that of ordinary gas.

The railroad trestle was soon on fire, and the firemen devoted themselves to saving this and the adjoining row of houses. Over at the electric lighting plant a big door had been blown in, breaking a steam pipe, and the works were shut down for a short time until this could be repaired. Sixty telephone wires ran past the wrecked buildings on poles. These were destroyed and the trolley wires were carried away. It was two hours before the cars could be run again, says the N. Y. Sun.

At 12:20 o'clock there was another violent explosion, doing considerable damage. The loss to the acetylene works alone was $20,000. The explosions of liquefied acetylene gas have been so numerous and serious that its manufacture should be prohibited until it can be made, stored, shipped and consumed with greater safety than is seemingly possible to-day.

SARDINES are now being packed in glass bottles, low wide-mouthed shape. They look much cleaner and they are far handier than the old-fashioned tins.

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Correspondence.

The Great Pyramid.

To the Editor of the SCIENTIFIC AMERICAN:

In your append to the letter of W. F. Quinby, in the SCIENTIFIC AMERICAN of December 18, you say, referring to the Great Pyramid: "As the upper tiers of stones are gone and the exact angle of the slope not determinable, the precise height of the pyramid is a matter of conjecture." This is, I think, a mistake. Prof. C. Piazzi Smyth succeeded in getting at least one of the corner sockets uncovered from the pile of debris under which it had been hidden for ages, and found *in situ* fragments of the casing stones, from which he was enabled to place the exact height of the structure beyond the shadow of a doubt. JOHN NICOL.

Tioga Center, N. Y., December 17, 1897.

[Our esteemed correspondent confuses work done in 1837 by Captain Howard-Vyse with that of Prof. Smyth a good many years later. Captain Vyse uncovered two of the corners of the Great Pyramid and found the seats of the corner stones in the natural rock. He also found two of the casing stones in position, and measured them. It is on these that Prof. Smyth depends for his data in his book, "Our Inheritance in the Great Pyramid;" see pages 22-26, 8vo edition, 1874. The angle of slope was 51° 50', from very careful measurements of the angle directly, but computed from the sides of the block the angle was 51° 52' 15·5"; and from this Prof. Smyth concludes that the exact angle must have been 51° 51' and some seconds. He thinks the seconds should be 14·3. Why is not very apparent.

At a later date Mr. W. Dixon found another casing stone (see the book referred to above, p. 490), which Prof. Smyth calls a "unique stone," and from which the angle of slope was measured as 51° 53' 15" and 51° 49' 55". This Prof. Smyth considers confirms his assumption, but he says, "The top and bottom surfaces are not quite parallel;" and also, "The original worked surface forming the back is entirely gone, and only fragments of the five other surfaces remain."

On these stones all inferences concerning the original height of the Great Pyramid are based. We are of the opinion that the determination of that height to a fraction of an inch is not possible from such data.—ED.]

Arctic Enterprises.

Mr. Peary has returned home from Great Britain and expressed himself as much gratified with the result of his trip. He spoke of Mr. Harmsworth's offer of the "Windward" in the warmest terms. Mr. Peary said: "The proffer was made unconditionally, with the exception that he expressly insisted that she should be used as a free will offering." The "Windward" is a vessel of 250 tons, brigantine rigged and furnished with engines for auxiliary power. She was built for a whaler and was formerly owned by the Hudson Bay Company. The "Windward" is a little smaller than the "Hope." Mr. Harmsworth will have her thoroughly overhauled and fitted with new engines and boilers and will send her over in the spring. Mr. Peary was well received when he addressed the Royal Geographical Society in London and the Royal Scottish Geographical Society. The leading scientific men of London examined the fragments of meteorite which he brought from Greenland last winter and pronounced it of undoubted meteoric origin. Prof. Ramsay, the discoverer of argon and helium, will examine drillings of the meterorite to ascertain if those elements are present.

As soon as Jackson, the explorer, has completed the work connected with the Franz Josef Land expedition he will start for the North Pole. He informed a reporter that his original plans were identical with those of Lieut. Peary, except that he intended to take the east coast of the island instead of the western, mapping out undiscovered land on the route, but since he heard Lieut. Peary's lecture he changed his plan, considering that the American had prior claims. Jackson now proposes to proceed by way of Davis Straits and Baffin's Bay, up the west coast of Elsmereland and Grinnell Land and thence across to the furthest point reached by Aldrich in 1876; he will then push northward in the direction of any land visible from the coast. The date of his departure is uncertain, and Jackson will only take one companion outside of his crew. He expects to be absent about two years.

The preparations for the Swedish Arctic expedition of 1898 are now completed. It will be under the leadership of Dr. A. G. Nothorst, who accompanied Nordenskjöld in the Greenland expedition of 1883. His main object is to examine the eastern side of Spitzbergen and the region between Spitzbergen and Franz Josef Land. As this area will not probably be accessible in the beginning of the summer, Dr. Nothorst intends to make investigations in western Spitzbergen, Northeast Land and Bear Island. He has bought the steamer "Antarctic," which in 1895 carried a whaling expedition to the South Polar seas. It is now being overhauled and equipped for the trip. The expedition will be well equipped for zoological, hydrographical and cartographical work.

Recent Archæological News.

The Nemi estate, near Rome, including the beautiful Lake Nemi and the woods which were famous for the worship of Diana, is to be sold at auction to pay the debts of Prince Orsini. Two famous pleasure triremes of Emperor Tiberius are submerged in the lake. We have published both a reconstruction of one of the vessels and also illustrations of the mooring rings and other parts of the boat. Lake Nemi is an extinct volcanic crater, and is of a perfect cup shape. It is one of the most beautiful spots in the world, and it is to be hoped that it will be bought by the government and kept intact.

The British Museum has just secured, through the generosity of the well known art collector George Salting, one of the most famous relics in existence. It is known by the name of the Santa Spina, and consists of a large amethyst of exquisite beauty and artistic interest, hollowed out to inclose a thorn from the crown of thorns of the founder of the Christian religion, while one side of the gem is covered by minute paintings on lovely translucent enamel. It was presented by Sultan Saladin to St. Louis of France, and was until a hundred years ago one of the most celebrated treasures of the French nation. Coming into the possession of the late Baron Pichon during one of the periodical revolutions which occasionally turn things upside down in France, it was put on the market at his death, and has now, after a good deal of negotiation, passed into the possession of the English government at a heavy price.

The Genizah or treasure house of an ancient synagogue in Cairo is described in The Times by Dr. S. Schechter, of Cambridge, England. It is a windowless and doorless room at the end of the gallery, with an entrance through a big shapeless hole reached by a ladder. Here, in obedience to the injunction upon the Jews not to destroy any of their sacred books, which finally came to include the preservation of all writings in the Hebrew characters, have been deposited, during the past two thousand years, worn out and defective copies of such books, sound copies of "disgraced" books (that is, such as have once pretended to the rank of Scriptures, but have been authoritatively condemned as uninspired), and various Hebrew documents. Some parts of the immense mass, which includes books printed during the last four hundred years, are in a fair state of preservation, others are squeezed into unshapely lumps, while still others are "literally ground to dust in the terrible struggle for space." Dr. Schechter was able to rescue about forty thousand fragments of manuscripts, which have been placed in the library of the University of Cambridge, and are now being carefully examined. They consist mainly of parts of the Old Testament, some going as "far back as the tenth century," of Jewish liturgical works, of the two Talmuds, very many hymns, legal documents, letters, prescriptions, amulets and fragments of miscellaneous works.

The Visibility of Colors at Great Distances.

In view of the accuracy of the long range small caliber rifles, interesting experiments were recently conducted by the Society of Civil Engineers in Paris, in order to determine the visibility of different colors. To designate the visibility of colors at great distances numbers from one to eight were taken, eight signifying invisibility. It was regarded as a matter of importance to determine how these numbers compare in clear weather, in cloudy weather and at night. The result of observation at 600 meters (650 yards) is given as follows: In clear weather white is most distinctly visible (1), then comes hussar blue, light blue (2), scarlet (3), green (4); gray and the color of dry foliage are almost invisible and were marked 7. Dark blue was called 6. In cloudy weather nothing was altered in case of white, blue, green and brown. Hussar blue becomes less visible (3), so also scarlet (4); on the other hand, green becomes more visible (3). At night the results were the same as in cloudy weather, except that white becomes invisible and so passes from 1 to 8.

The colors of the German and Italian infantry (iron gray and dark blue) were classified as 6. In France, in consequence of the red képi, the dark blue coat and the scarlet trousers, the average number obtained was 4½. But it is believed that in reality the disadvantage of the French infantry will turn out to be less, because only that part of the red trousers between the lower edge of the coat and the top of the bootee is visible, and even this will be so dusty after the first day's march that no actual color will be visible. The light reflected from cuirasses, helmets and sabers is not taken into account.—Schweizerische Militärische Blätter. Translated by The Journal of the United States Artillery.

Eighty-seven Warships Building in Britain.

The general disposition to increase naval armaments can be gaged by the fact that 87 warships are building in Great Britain alone. They aggregate a displacement of 318,612 tons. Of the 87 warships, 34 go to foreign governments.

Science Notes.

The draining of a pond at the State Hatchery, St. Joseph, Mo., a few days ago for the purpose of removing the bass to another pond furnished a surprise to Fish Commissioner Yenawine and Superintendent Carson. So few bass were found that they suspected some thief had captured the former inhabitants of the water, but a short time after the pond was drained one of the men stumbled onto a fish in walking over the partially dry bottom of the pond, and, upon picking it up, he found a bass, and investigation revealed a large number of the fishes ensconced in the mud, some of them twelve inches below the surface. Commissioner Yenawine thinks this experience should set at rest all doubts as to whether the black bass hibernates in the mud in the winter.

Some ten years ago Weber discovered, says Nature, that a heated body begins to emit visible radiations at a lower temperature than that at which it exhibits the well-known glow of red heat. This "gray glow," as it has been termed, has been investigated from a physiological standpoint by Herr O. Lummer (Annalen der Physik und Chemie, 62). According to the author's theory, the observed appearances are due to the different susceptibilities of the rods and cones of the retina to light of varying intensity, the gray glow being perceptible only to the rods, while the red glow stimulates the cones. It is proposed to make observations of the lowest temperature at which luminosity occurs. Herr Lummer expresses the view that this temperature depends in some degree on the area of retinal surface exposed to the radiations.

Scientists rarely agree in their estimate of the probable heat of the sun, though it appears that the same opinion on this point is shared by Prof. Langley and Lord Kelvin, whose calculations fix the temperature of that luminary at about 8,000° Centigrade. They arrived at this result from figures based on solar photospheres. The eminent Italian astronomer and mathematician, Secchi, gave it as his opinion that the temperature could be but little, if any, short of 10,000,000° Centigrade; Sporer thought it might be 37,000°, while Pouillet brought it down to somewhere between 1,400° and 1,800° of the same scale. M. Becquerel's opinion was in substantial agreement with that of Prof. Langley. Again, M. St. Clair Deville declares that the heat of the solar surface does not give evidence of being in excess of 2,800°—this conclusion being in accordance, also, with the conclusions arrived at by Bunsen and Debray. But Sir Robert Ball, professor of astronomy at Cambridge, England, is quoted as rating the effective temperature of the sun as probably 18,000°.

Milton Whitney, Chief of the Division of Soils of the Department of Agriculture, in his annual report to the secretary, says: "The electrical method of moisture determination has been still further perfected. Sixteen stations have been equipped with electrical instruments in various parts of the country, and in several important types of soil. Records have been kept at these stations for periods varying from two to four months, and it has been found that the method can be used by anyone with ordinary care. As a result of these field records, I feel perfectly satisfied with the operations of the method, and equally satisfied that it will prove of great value in soil investigations, as well as of practical and commercial value. One great value of the method is that the electrodes are permanently buried in the field at any depth desired, and the field can be cultivated or cropped as usual. The electrical resistance between the electrodes is read from a scale, and this resistance varies according to the square of the water contents. By once thoroughly standardizing the electrodes and by the use of tables furnished by the division, the moisture contents of the soil can be determined at any time from the electrical resistance of the soil."

Preservation of Eggs.—Experiments have been made by Director Strauch, of the Agricultural School in Neisse (Germany), with various methods for keeping eggs fresh. At the beginning of July 20 fresh eggs were treated by each method and examined at the end of February. The results, says The Pharmaceutical Era, are given below.

Kept in brine: All unfit for use. Not decayed, but unpalatable from being saturated with salt.

	Per cent spoiled.
Wrapped in paper	80
Kept in a solution of salicylic acid and glycerine	80
Rubbed with salt	70
Packed in bran	70
Coated with paraffin	70
Painted with a solution of salicylic acid and glycerine	70
Immersed in boiling water 12-15 seconds	50
Treated with a solution of alum	50
Kept in a solution of salicylic acid	50
Coated with soluble glass	40
Coated with collodion	40
Coated with varnish	40
Rubbed with bacon	30
Packed in wood ashes	20
Treated with boric acid and soluble glass	20
Treated with potassium permanganate	20
Coated with vaseline and kept in lime water	All good
Kept in soluble glass	All very good

—Südd. Ap. Zt.

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DECIMALIZATION OF THE DAY.

If the commission on the decimal hour has not given a complete solution of this important question, the reason for it must be looked for in the very legitimate fear that it has had of imposing upon the public a new division of the time, a new value for each fraction of the time, and a new face for all the timepieces now in use.

In order to avoid an abrupt transition in the habits of routine of the public, there is quite a simple method to be employed, and that consists, as shown in Figs. 1 and 2, in providing watches with two faces, one giving

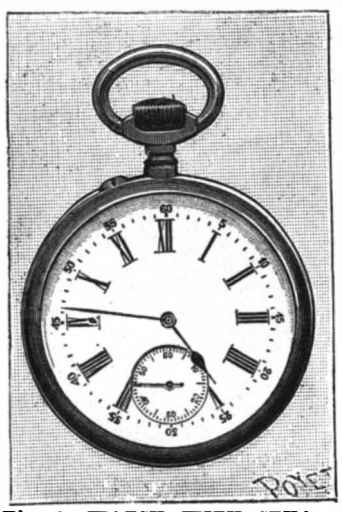

Fig. 1.—WATCH WITH SEXAGESIMAL DIVISIONS.

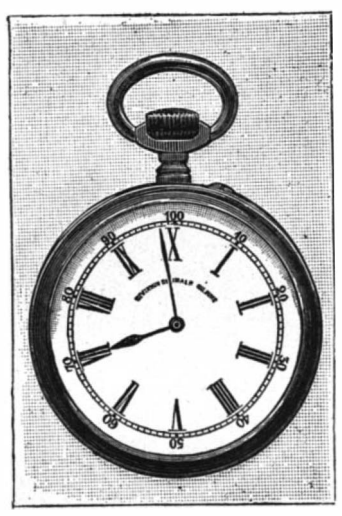

Fig. 2.—WATCH WITH DECIMAL DIVISIONS.

the present sexagesimal time (Fig. 1) and the other (Fig. 2) the decimal time. In this way, a person who carries a watch that gives both the divisions of the time will very easily get used to reading the two dials. There is but a single setting of the watch required, it being impossible to move the decimal hands without moving the sexagesimal ones also.

The four hands starting from midnight, the hour hand (Fig. 1) makes two revolutions of the dial in twenty-four hours, while the decimal hour hand (Fig. 2) makes one revolution a day of ten decimal hours.

In order to avoid too great a complication in the ordinary watches, the seconds hand is for the present suppressed in the decimal dial; but in the decimal instruments of great precision constructed by M. De Rey-Pailhade, the decimal seconds hand has been retained, and gives the $\frac{1}{100000}$ of a day. Fig. 3 represents a decimal watch that once belonged to M. Saint-Just, one of the members of the National Convention.

We are indebted to La Nature for the engravings and article.

THE REDWOOD FORESTS OF HUMBOLDT COUNTY, CALIFORNIA.

The accompanying illustration presents a typical scene in the celebrated redwood forests of Humboldt County, California, from which a 15-foot slab of wood was recently cut and shipped to London for manufacture into the top of a dining room table. Humboldt County contains an almost unbroken belt of timber which runs parallel with the coast for one hundred miles and extends about eight miles inland. It has been estimated that the redwood forests cover 538,000 acres, of which about 40,500 acres have been cut down. The forests of redwood now standing are estimated to be capable of producing 100,000 feet of marketable lumber to the acre.

It is a fortunate peculiarity of the redwood forests that they are apparently imperishable, as far as the forces of nature are concerned. The stumps do not die, but send forth shoots which would in the course of time, if left alone, renew the forests. Moreover, the forests offer a stubborn resistance to the ravages of the forest fires which are so destructive of the timber in other parts of the Pacific Coast. The very wood itself burns sluggishly, even when it is dry, and the density of the forest growth, by shutting out the sun, retaining the moisture of the soil, and taking up and holding the dampness of the fogs and sea breezes, prevents the fire from taking hold of the underbrush. A fire will sweep through the pine or spruce belts which border the redwood forests, but it will fail to take any firm hold upon the latter. Even when the trees have fallen they appear to suffer no further deterioration than the loss of their bark. The composition of the timber is such that it seems to be almost entirely proof against the action of the elements. It is these enduring qualities among others that render these forests so especially valuable; since, unlike those of fir and pine, they are not liable to be swept out of existence in a single conflagration.

The base of the tree in the illustration shows the way in which this monster, measuring 16 feet in diameter, was felled. The rough surface, on which the marks of the ax are plainly discernible, shows where the V-shaped cut was made by the axman, the smooth surface was made by the cross-cut saw, and the jagged strip across the center shows the remaining wood that was broken across as the tree bent to its fall.

A FALLEN GIANT IN THE REDWOOD FORESTS OF CALIFORNIA.

The Psychology of the Battlefield.

In a paper on the "Psychology of the Battlefield," read before the Royal United Service Institute, Mr. W. V. Herbert, late captain in the Turkish army, said: "The constituents of a body of fighting men, say a company of infantry, are: Absolute cowards and absolute heroes, an insignificant minority; average men, a vast majority. 'Absolute cowards' are men totally deficient in all such qualities as act on the battlefield as counterpoises to the fear of death natural to man: patriotism, piety, faith, pride, vanity, gratitude, loyalty to cause, king or country. 'Absolute heroes' are men who are ever ready to sacrifice their lives to an idea, whether right or erroneous. 'Average men' are men in whom the normal, natural and perfectly praiseworthy love of life can be overcome only in certain exceptional conditions and chiefly by the superior will power of other men, i. e., leaders.

"Men incapable of being soldiers and dangerous on the battlefield (leaving out of the question self-evident cases, such as men addicted with and obnoxious by reason of notorious vices) are: Malcontents; men who have a grudge against the country. For out of these deserters, spies and traitors are formed. Degenerates—The conclusion which all specialists have arrived at is that degenerates (though they may be geniuses in certain arts and capital men of manual labor or handicraft) are incapable of performing duties for the doing of which a connected train of argument is requisite (for instance, sentry, observation, transmission of orders, command of others), since in them the 'current' between the conception of cause and effect is interrupted. In such men the perception of the senses, though in itself unimpaired, does not cause a corresponding image in the brain—that is, a defined idea. For instance, a 'degenerate' sentry will hear the noise of wheels, but be unable to argue therefrom that a vehicle is approaching. In every man—even in the

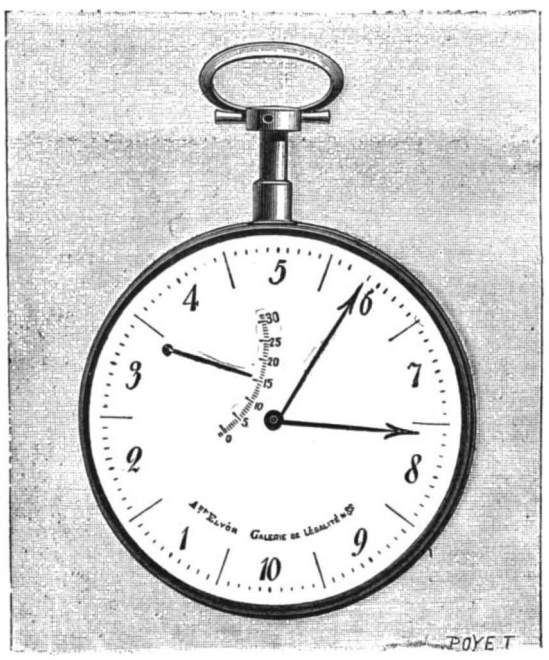

Fig. 3.—A DECIMAL WATCH.

fool—there are latent stupendous possibilities. The latent powers of men of resistance and endurance are enormous. The battlefield is the place, the immediate superiors (the company officers) are the persons, to bring them out. For this end drill books and works on tactics are of no avail, since these start from the mistaken basis that all men are always courageous and reliable.

"An officer who, in the turmoil and deviltry of battle, cannot bring his will to bear immediately and irresistibly upon the minds of those under him has failed in one of the elementary duties of his profession, and had far better embrace another and less ambitious calling. Skobeleff said that a position carried by attack can be held even if 75 per cent of the original attacking force have perished. Military history proves that such positions are abandoned when 25 per cent have succumbed. That is so because generally all the officers are among the slain and the incapacitated, and there is no will power left to guide the dormant will power of the survivors. How to provide for such an emergency is the business of those who have the organization of an army in their charge."—Army and Navy Journal.

THE Smithsonian Institution has come into possession of the Hallett Phillips collection of Indian implements and antiquities from the Potomac Valley. It is reputed the largest collection of its class in the world, and its value is enhanced greatly by the careful arrangement and record of individual specimens. The collection consists of over 20,000 pieces, principally spear and arrow heads, stone knives, hammers and scrapers, fragments of pottery, and soapstone utensils. Mr. Phillips made a long study of prehistoric man in the Atlantic tidewater region. In his opinion, Washington was not the first capital on the banks of the Potomac. He believed the site, owing to its great advantage in connection with stone quarries and the river fisheries, was the headquarters of the great Algonquin confederacy. The Phillips collection is said to be the best key in existence to the manners and habits of this vanished race, of which written history gives little information. Mr. Phillips was drowned recently in the Potomac. The collection passed to the custody of the Smithsonian Institution through the generosity of Mr. Thomas Lee, to whom it had been bequeathed.

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A Notable Astronomical Work.

In a finely printed quarto of nearly 600 pages, the heirs of the late Dr. Benjamin Apthorp Gould have just presented, says The Evening Post, to astronomers the substantial completion of the photographic work undertaken by him twenty-five years ago at the Argentine National Observatory in Cordoba. Although Dr. Gould did not live to see the completion of this task of his inception, still all had been so nearly finished that, with Dr. Chandler's supervision, the whole is now brought forth in entire harmony with the original plan. On Dr. Gould's first going to the southern hemisphere, celestial photography had not yet yielded tangible results in the line of accurate stellar positions, chiefly because the now familiar dry plates were not then available. Much pioneering thus was a matter of necessity; and the misfortunes and obstacles that beset his endeavors were most astonishing—not the least of them a broken object glass, the death of two photographers from pulmonary disease and of a third from a stroke of lightning. The Argentine national government has, however, supplied the necessary funds for preparation and publication, and the finished volume now before us, really monumental in character, gives the accurate positions of nearly 10,000 stars, with a chapter devoted to each of 37 stellar clusters, mostly in the southern celestial hemisphere and invisible from observatories generally in the United States. The conclusion of a significant labor like this, in a field by no means yet overworked, may well induce pride not only in the astronomers whose patient faithfulness has conducted it through all these years, but in the enlightened officials of a sister republic whose helpful generosity alone has made it possible.

PERIOPHTHALMUS KOELREUTERI LEAVING THE WATER.

AMPHIBIOUS FISHES.

BY C. F. HOLDER.

Recently, in collecting below the high tide mark on one of the Pacific coast islands, the writer found beneath almost every stone overturned a little fish, literally out of water and in no way inconvenienced by the lack of its native element.

In the majority of instances the fishes were clinging to a stone by a singular sucker formed by the anal fins. They had been left by the retreating water, but had apparently preferred the change and were now for several hours breathing air directly instead of taking it from the water after the manner of fishes in general.

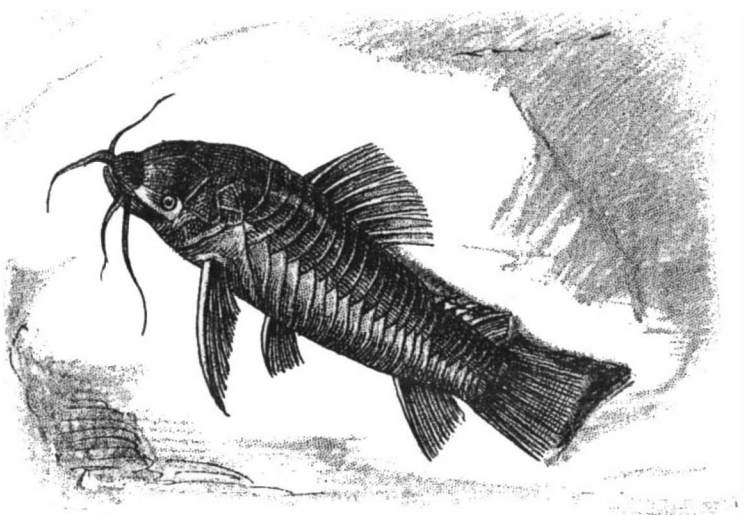
This peculiar habit has been observed in the European blenny (Blennius pholis). In specimens kept in an aquarium it was found that they became restless when the tide went out. The observer now placed a stone in the water, and the little fish at once crawled upon it and rested there, after the manner of a frog, for over an hour, then returning to its native element. Such fishes are almost as truly amphibious as the frogs and other animals which appear to be equally at home on land or in the water. The case of the blenny would seem to be remarkable, but there are a number of fishes, shown in the accompanying illustrations, which are not only able to breathe out of water, but habitually seek their food on land.

The most interesting examples are found among the Gobies of the tropics. The head in this fish is large, the eyes conspicuous and protruding, the pectoral fins powerful, resembling legs more than fins, and capable of lifting the fish and enabling it to jump along the sands or muddy shores of certain tropical islands. Two genera are known, Periophthalmus and Boleophthalmus, both equally remarkable for their amphibious habits. They are particularly fond of a shelless mollusk known as Onchidium, which is often left stranded on the shore, to obtain which the fishes crawl out upon the muddy flats and hop along like frogs. They are so active that it is difficult to catch them. Col. Nicolas Pike informed the writer that he secured his specimens by shooting them with a shotgun. This was at Mauritius, at Matuku Island. Prof. Moseley, the naturalist of the Challenger expedition, found them in great numbers also at Ceylon. They were hopping about on the mud flats beneath the mangrove trees, and Prof. Moseley states that when pursued they prepared to escape by taking to the land rather than to the water. At each jump they would clear a foot. He says: "I have chased one at Trincomali Harbor, which skipped along before me until it reached a rock, where it sat on a ledge out of the water in the sun, and waited till I came up, when it skipped along to another rock." The species at the Fijian Islands is P. Koelreuteri, and it is usually found sitting or resting upon the dry roots of the mangrove trees, perfectly at home out of water.

When the account of these fishes was first related in Europe it was not believed, but finally it was accepted, and specimens of the fishes may now be found in every well-ordered and equipped museum.

The first fish ever observed to leave the water, by a European naturalist, was the now famous climbing perch (Anabas). Daldorf in visiting India heard the story as told by natives, to the effect that these fishes left their native element and walked overland, using their fins as limbs, but did not believe it. One day a native came to his camp and offered to take him to a spot where the emigrating fishes could be seen. Following the man through the forest, they finally came to a pool or swamp that was rapidly drying up, and from the mud proceeded a line or procession of fishes, making their way up through the grass by the aid of their fins, presenting a remarkable spectacle. The fishes were emigrating overland; the water of their pool had dried up, and they were deliberately marching away in search of a locality better suited to a water-loving community.

Daldorf later saw these fishes climbing small palms, presumably in search of food, though regarding this there is much doubt. In certain parts of India this migratory habit of fishes is so well known that the natives anticipate and repair to the localities with baskets and capture them by hundreds. Mr. E. A. Legard states that on the Singalese River also this habit is so well known that all the inclosures in which the Anabas are kept are provided with covers, to prevent the fishes from climbing out.



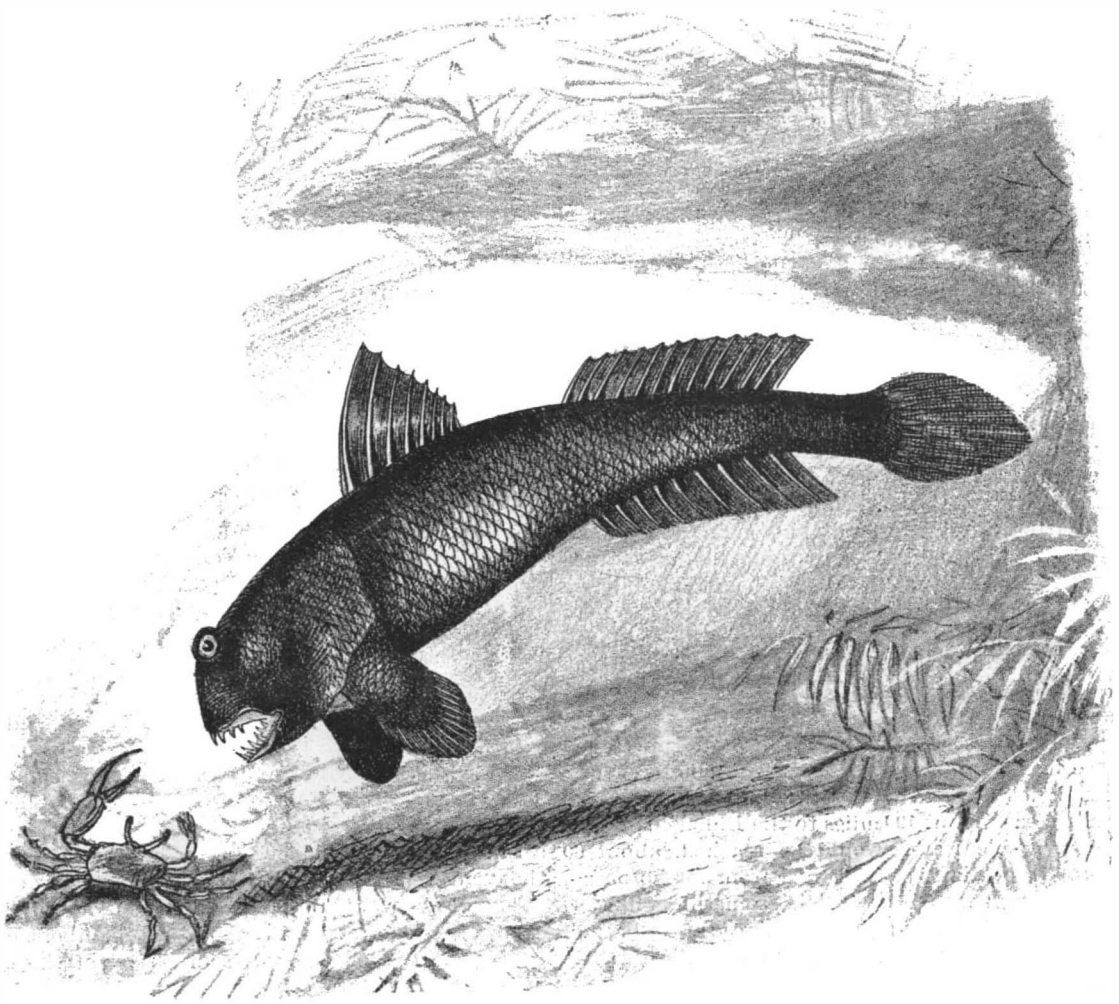
CALLICHTHYS CRAWLING ON DRY LAND.

A little fish (Gobius soporator), common on the coast of Texas, is almost equally remarkable. A naturalist, in collecting specimens, placed them in a pail, but was astonished, upon returning, to find that the fishes had all crawled up the sides, and were slowly but surely making their way to the water, and were apparently not inconvenienced by the change of element.

Almost equally interesting are the fishes which, at the approach of dry weather, descend into the ground and form cases perfectly devoid of water, in which they lie in a state of seeming hibernation until the water returns again. This habit has often been productive of great astonishment on the part of those not familiar with the fish and its ways. Thus, several years ago a gentleman living in England received a box which apparently contained lumps of clay. Not understanding it, he stored the box away in his warehouse. In the course of three weeks he received a letter from a friend stating that on the previous steamer he had shipped him a lot of small American fishes (see illustration No. 1). He furthermore stated that to be made available for aquarium purposes the earth balls must be soaked in tepid water. This was done, and, to the surprise of the gentleman, each ball produced a small fish, which, perfectly dry, had been packed away in its burrow in a state of presumable hibernation.

In Gambia the fish Protopterus has a similar habit. At the first suggestion of the dry season it begins to explore the mud in the bottom of the stream in which it is living and there forms a burrow in which it spends the weeks and months with not a drop of water until the rainy season begins again and it is released.

The natives of Kottiar repair every year to the dry banks of the Vergel River and dig out certain fishes by hundreds as they would potatoes. They perform the work with pick and shovel, the fish in its case being dropped heavily, breaking open, displaying the animal



PERIOPHTHALMUS FEEDING ON LAND.

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eight or ten inches in length and often as lively as though taken directly from the water. It is evident that these fishes, which can so readily change their method of life, must in some way differ from their companions which find water an essential. An examination of the fishes shows that they have gills over which water flows and by which air is taken and made to serve its peculiar purpose. In other words, they have true gills, but in Periophthalmus and Boleophthalmus the gill cavity is much larger than in many fishes and the gills do not fill it, leaving a space which might be filled with air or water.

In other fishes which habitually leave the water, as Anabas already referred to, the gill cavity reaches upward, the mucous membrane forming a complicated foliated labyrinthine structure, so that the gills really present more of a surface than those of ordinary fishes, which spend all their time in the water. This labyrinthine structure long ago attracted the attention of naturalists, and it was supposed to be a provision for the storage of water when the fish was traveling overland; but investigation does not carry out this idea, and it has been shown that the cavities never contain water and are in no sense reservoirs.

The theory held to-day is that the complicated organs are so adapted that they permit the animal to breathe either in the water or directly from the atmosphere. In other words, the labyrinthine organs are lungs, formed, according to Semper, "by modification of a portion of the water-breathing gill-cavity; the fishes that have them are therefore to be regarded as amphibious with quite as much reason as toads and frogs, or even better, since they are capable of changing the nature of their respiration—of air, that is, or of water—at will and suddenly, without any interruption; nay, are actually accustomed so to change it."

Central American Railway Enterprises.

In answer to many inquiries from contractors, manufacturers of supplies and railway men seeking employment, The Railway Age has prepared the following review of the principal railway enterprises in each of the five republics of Central America:

GUATEMALA.

The Guatemala Central Railway has been for several years in operation from San Jose, on the Pacific, northeasterly to Guatemala City, 71 miles. It is owned by C. P. Huntington and other Californians. The Guatemala Northern Railway, in which the government has a considerable interest, is intended to run from the harbor of Puerto Barrios, on the Atlantic coast, to Guatemala City, a distance of 160 miles, thus completing a transcontinental road. Track is laid to within about 60 miles of the capital. Work has been undertaken at intervals for many years, and as often suspended on account of political or financial complications. If stable conditions were assured in Guatemala, it would not be difficult to secure American capital and skill to push this important road to completion.

SAN SALVADOR.

This little republic, lying on the Pacific coast, with Guatemala on the west and Honduras on the north, recently celebrated the completion of its government road from Acajutla, on the coast, inland to Santa Ana, about 50 miles. It was proposed to build a branch to Ahuachapam, on the Guatemala frontier, and by extension eventually to obtain connection with the transcontinental line from Puerto Barrios, but the hostile relations between the two countries at present render the prospects very uncertain. Concessions have been granted for two or three short lines in the republic.

HONDURAS.

Special attention has been directed to this country by the recent granting of a concession from the government of Honduras to a number of well-known Americans, for the construction and operation of a railway from Puerto Cortez, on the Atlantic, to Fonseca Bay, on the Pacific. This would form a transcontinental line about 210 miles long, running almost due north and south. The concessionaires are: Chauncey M. Depew, W. Seward Webb, John Jacob Astor, Benjamin F. Tracy, J. G. McCullough, Frederic B. Jennings, George S. Scott, Nathaniel A. Prentiss, Charles McVeigh and Melville E. Ingalls, Jr.—names which are sufficient vouchers for the good faith of the enterprise. The government now owns a short road from Puerto Cortez to La Pimienta, about 30 miles, which is to be turned over to the syndicate, together with a grant of 100 feet of land on each side of the line and 5 square miles of land for every mile of railway; also the use of all construction material which can be obtained from government land, exclusive mining rights on all lands granted to the railway, and various other privileges. The syndicate, on the other hand, obligates itself to liquidate the public debt of Honduras, and in this connection it will establish a bank under government supervision, to be called the Commercial Bank of Honduras, with a minimum capital of $500,000. The road, which is to be of not less than 3 feet 6 inches gage, may be bonded for $20,000 per mile. At the end of 99 years the road and all its appurtenances will become the property of the state, but the government reserves the right to purchase the road after it has been in operation for 75 years.

It is provided that 25 miles shall be constructed in the first year and that the entire road shall be completed in six years. Also that a branch shall be built to Tegucigalpa, the capital of the republic.

Some years ago Mr. S. B. McConnico, then general agent of the Illinois Central at New Orleans, obtained a concession for a railway from Truxillo, on the north coast, into the interior, and made investigations which showed that a great business in bananas and other fruits, in choice woods, etc., could be expected. It is not unlikely that this project will be revived.

A French syndicate a few years ago obtained a concession for building a narrow-gage road 93 miles long, from the Pacific Ocean to the capital, Tegucigalpa, following the course of the Rio Grande. It would open rich mineral and agricultural lands.

NICARAGUA.

This republic, whose name has become so familiar in connection with the proposed canal from Greytown to San Juan, has made small progress in railway building. The government railway system consists of a road from Corinto, on the Pacific, easterly to Momotombo, on the northwestern shore of Lake Managua, 58 miles, and another section from Managua, the capital city on the southern shore of that lake, to Granada, on the northwestern shore of Lake Nicaragua, 33 miles, a total of 91 miles. In connection with steamer service on the two lakes and on the San Juan River, these roads form part of a trunk line of communication through the country from sea to sea. But the roads have not been successful, and the Nicaraguan government, which is heavily in debt, has decided to send a commission to the United States and offer the railways and steamer lines for sale. The Railway Age has received from the State Department at Washington some information of interest on this subject, sent by United States Consul Paul Wiesike, at Managua. The consul says:

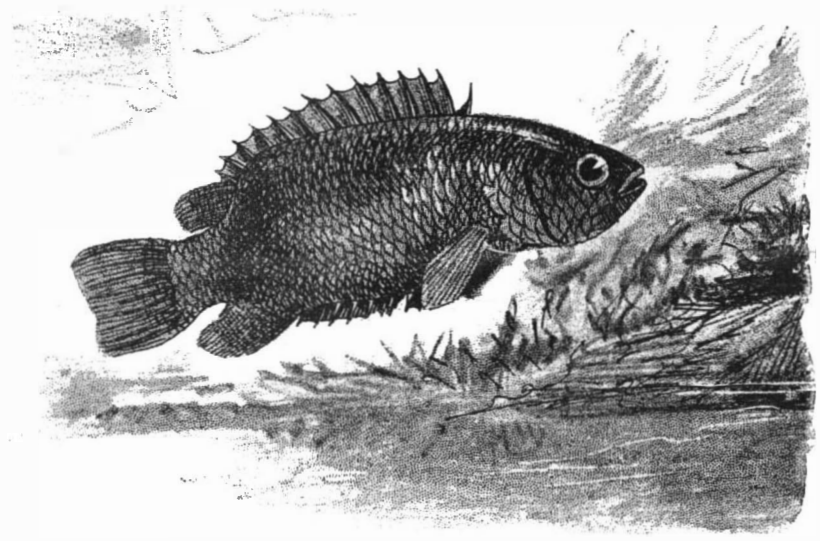
"The Nicaraguan government is in great need of money, and the railway does not pay any longer. The gross earnings last year were about $400,000, silver, and the running expenses $310,000. The road is mortgaged to the English bondholders of the national debt for £285,000 ($1,425,000), the interest on this sum being secured by the export duties on coffee.

"It is apparent that the road, whose profits, on account of bad management and increase of expenses for repairs, during the last four years, are 25 per cent less than they had been, would be a paying enterprise under a good management of an American company that would buy or lease it from the Nicaraguan government, and would invest a sum of money besides for necessary improvements, and that such arrangement may lead to the completion of the interoceanic railroad in Nicaragua. And this is the main point—if Americans do not buy or lease the national railroad of Nicaragua, it will fall into the hands of the English bondholders and our opportunities for trade development in this republic will experience another setback."

Several railway projects that have been sanctioned by government appear to be awaiting better times. They include (1) a road from San Miguellito, on Lake Nicaragua, east about 100 miles to the Bluefields River, where navigable water would be reached, about 60 miles from the Atlantic; (2) a road from Momotombo, on Lake Managua, to Rio Grande, something like 200 miles, and within 100 miles of the Atlantic; (3) a branch of the government road from Misaya to the Pueblos district on the Pacific coast, about 16 miles.

COSTA RICA.

The construction of perhaps 50 miles would complete a transcontinental railway across the narrow isthmus forming the republic of Costa Rica. A road has for some time been in operation from Port Limon, on the Atlantic, to San Jose, the capital, something like 100 miles. It was intended to continue it to the Pacific at Punta Arenas, but a government commission has recently decided that Tivires, about 20 miles south of Punta Arenas, is the better terminus, and that about $1,000,000 can be saved by building to that point. The cost of the extension is estimated at $5,000,000, which does not include the $1,500,000 that will have to be spent to make a harbor at Tivires. Evidently these figures are not on a gold basis. A survey of this route was completed a year ago, and the congress recently ordered the work to proceed and empowered the executive to make contracts for building the railway and the harbor. The surplus revenue is to be applied to this purpose "after the establishment of the new national money." Whether the Costa Rican finances are in such a condition as to make contracts in connection with this work desirable is a question upon which information is needed.



AMPHIBIOUS FISHES—ANABAS SCANDENS MIGRATING OVERLAND.

An Anti-Spiritualist Society.

So much fraud has been practiced under the name of spiritualism in the past few years that it has been a difficult matter to keep it respectable as a belief by those who regard it as a religion.

The methods employed by numerous so-called spiritualists to entrap their victims are not well understood, and by many not even suspected. The physical test mediums of the itinerant circuit are not nearly so dangerous as are trance mediums, who pretend to be proficient in clairaudience and clairvoyance. Local mediums usually act as information agents to those who are more adept in this pernicious art of deception. How often we hear it said, "Why, they told me things no one could have known unless they had been acquainted with my family for the past twenty years;" but it seldom occurs to these people that eavesdropping confederates have gathered enough material for the pretended communications, having gleaned their information while acting possibly as book agents or trinket peddlers. Physical test mediums are often run out of business by vigilance committees who unmask these pretenders, but in many cases the trance speakers are allowed to carry on their nefarious practices. Every phase of pretended mind reading by the aid of spirits has been outdone by hypnotists, muscle readers and by persons who have given definite study to psychic research reports, and investigation committees have ascertained the true causes of certain phenomena purporting to proceed from the spirit world.

The object of the National Anti-Spiritualist Association of America is to urge to the front the most plausible theories upon which spiritualists base their revelations. By combining together those who are opposed to spiritualism it is thought they will be able to meet the mediums squarely, and they propose to undermine their influence by publishing books, tracts, pamphlets and periodicals relating to the teachings and practices of the spiritualist. The society will soon have lecture committees, which will be prepared to furnish lecturers willing and ready to combat the mediums upon their own ground. This association is bringing to its support a large number of people interested in putting a stop to such false representations of alleged materializations as are constantly occurring. Membership in the society costs but a small sum, and the president is Rev. H. J. Decker, of Dayton, O., who is energetic in acquiring information and in prosecuting the work of exposure. One of the best helps he has, is our new work entitled "Magic: Stage Illusions and Scientific Diversions, including Trick Photography," which contains a number of exposés of tricks of spiritualistic mediums. Several papers have, by permission, published some of these tricks, in the hope of combating spurious spiritualism.

A Transatlantic Yacht Service.

It is stated that a yacht service for transatlantic travel is now under consideration. It is proposed to build a 2,000-ton four-masted schooner equipped as a yacht. The idea is to carry no freight and only saloon passengers. There are many for whom seasickness has no terrors and they would welcome such a yachting trip across the Atlantic. It is believed that there are enough people who would like to go in a sailing ship with all modern improvements to make the venture a success financially. Twin screw engines of low power would be provided to be used only in the event of a dead calm. Refrigerating chambers, evaporators and distillers would form a part of the equipment, so that all the comforts of the best liners would be secured. The service would, of course, be a summer one.

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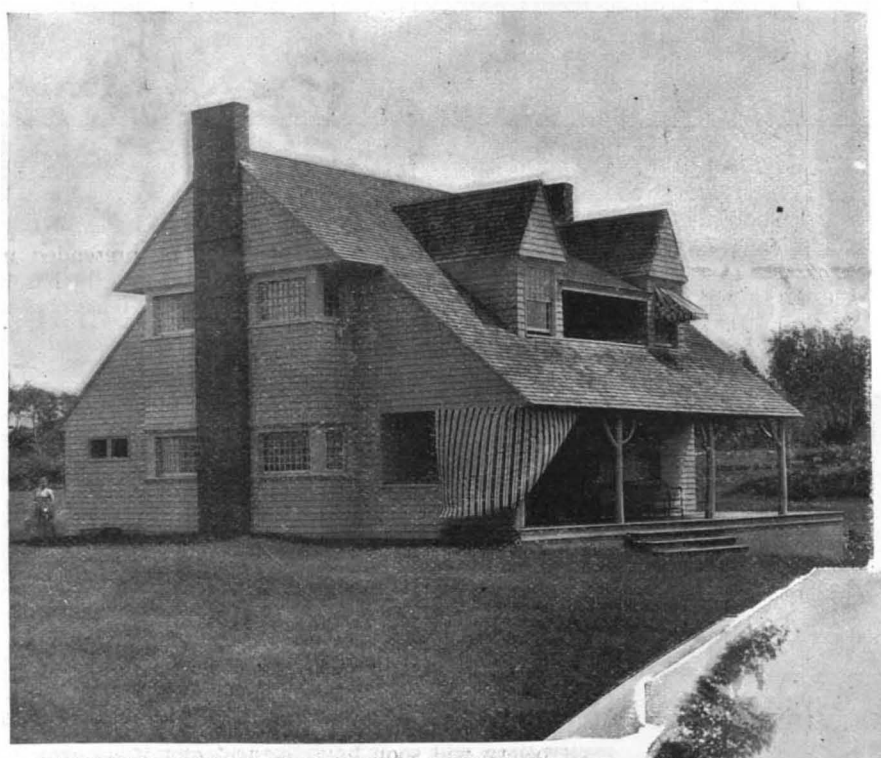
SOME AMERICAN COTTAGES.

We present four engravings of cottages which have been recently erected in various parts of the country. The cottage at Binghamton, N. Y., is the property of G. S. North, Esq., and the architect was Mr. Elfred Bartoo, of Binghamton. The underpinning was built of rock-faced stone; the exterior framework is covered with sheathing and paper. The first story was covered with clapboards and painted Colonial white with yellow trimmings. The second and third stories are partly covered with shingles, while the remaining walls are half-timbered, with the spaces filled in with stucco work painted yellow with white trimmings.

COTTAGE AT BINGHAMTON, N. Y.

The interior throughout is trimmed with whitewood. The hall contains an ornamental staircase, turned out of sycamore, with a paneled seat at side. The parlor and dining room are separated by an archway with spindle transom, while the library has an open fireplace with tiled hearth and facings and mantel of handsome design. The dining room has a false fireplace trimmed in a similar manner. The kitchen and pantries are wainscoted with narrow beaded stuff and are provided with all the necessary fixtures of the best improved kind.

A residence was erected at Hackensack, N. J., for Mr. Frederick W. Pangborn, by Mr. Charles N. Hoar, architect, New York City. The cost complete was $5,000. The house has a gambrel roof. The spacious piazza is one of the interesting features of the building The underpinning is built of red brick, and the house is covered with shingles stained a dark red, while the trimmings are painted cream white. The roof is also shingled and is painted green. The hall and parlor are trimmed with white pine, treated natural, and each is separated, one from the other, by massive fluted columns of the Doric order. The hall contains an ornamental staircase turned out of oak. The parlor has an open fireplace, built of buff brick, with heart and facings of same, and a mantel shelf. The library has a paneled ceiling, and an open fireplace built of red pressed brick with hearth and facings of same, and mantel book cases are built in on either side of fireplace. The dining room, trimmed with natural white pine, has a bay window thrown out, door opening out upon porch, and an open fireplace built of mottled Tiffany brick. The second floor is trimmed with white pine and it contains four bedrooms, dressing room, bath and large closets. The bathroom is wainscoted and furnished with porcelain fixtures. The hardware and gas fixtures are of wrought iron.



SUMMER COTTAGE AT CUSHING ISLAND, MAINE.

The summer dwelling at Cushing Island, Me., shown in our engraving, was erected for M. S. Gibson, Esq., and the architect was Mr. John Calvin Stevens, Portland, Me. It was built for $2,000, and shows what can be done in the way of building a handsome little seaside cottage with a moderate expenditure. The house is built on cedar posts, and the exterior framework is sheathed, then covered with shingles and painted chrome yellow. The roof is also shingled, and is painted a moss green. The interior is trimmed with whitewood, and finished natural. The walls and ceilings are ceiled up with narrow beaded stuff. Hall contains an ornamental staircase. Living room is provided with window seats and a large open fireplace, trimmed with tiles, and mantel. Parlor has a similar fireplace. Dining room is provided with a large pantry. Kitchen is wainscoted and furnished with the usual fixtures. Second floor contains four bedrooms and large closets.

COTTAGE AT HACKENSACK, N. J.

The Colonial residence at Springfield, Mass., was built by Mr. Guy Kirkham, architect, of Springfield, for N. N. Fowler, Esq. The cost was $13,600 complete. The engraving presents a Colonial design with swell bay windows, and a colonnaded entrance porch at front, together with the porte cochère entrance at one side and a private piazza on the other. The underpinning is built of brick. The plan is excellent, with a large hall running through the center of the building, with rooms placed on either side. At the intersection of hall and staircase hall, a cluster of arches is provided, with spindle transoms. The stairway is an ornamental one, with spindle balusters, and newel post formed of a cluster of similar balusters. The parlor and library are trimmed with cherry, and both have open fireplaces with tiled hearths and facings, and mantels of similar wood and handsomely carved. The sitting and dining rooms are trimmed with quartered oak, and they have open fireplaces and bay win-

COLONIAL RESIDENCE AT SPRINGFIELD MASS.

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dows. The kitchen and its apartments are trimmed and wainscoted with Michigan pine and finished natural.

Our engravings are taken from the Building Edition of the SCIENTIFIC AMERICAN. Those of our new readers who are not familiar with this publication may be interested to know that this is a handsome monthly publication filled with beautiful half tone engravings of modern American houses. Each number is provided with a colored plate which forms the cover to the paper. Any readers who have already subscribed to the SCIENTIFIC AMERICAN can obtain the benefits of the combined rates by subscribing now for the Building Edition.

Affinity and What It Signifies.

Beeton says the word affinity appears to have been employed for the first time by Barkhausen, a German chemist, in his "Elements of Chemistry," published at Leyden in 1703. The elder Geoffrey issued the first table of affinities fifteen years later; and more extensive tables were afterward compiled by Wenzel, Bergmann, Guyton, Morveau and other chemists of the last century. Affinity or chemical attraction is the force which causes the particles of dissimilar kinds of matter to combine so as to form new matter. This definition indicates the differences between affinity and cohesion, which is another modification of molecular attraction. Cohesion merely binds similar particles into a mass; affinity brings about the combination of heterogeneous particles and causes them to lose their individual properties. The change of characters which follows the action of affinity is very wonderful. For example, the inflammable metal sodium unites with the suffocating gas chlorine, and the compound thus produced is chloride of sodium, or common salt, a substance which does not bear the slightest resemblance to either of its components. Chemical combinations do not take place indifferently, but in accordance with certain strict rules or laws. One substance will unite with another in preference to a third, or in some cases in preference to any other. This preference is denoted by the term elective affinity. By means of this discriminating action of affinity some combinations may be decomposed. If, for instance, there be a substance (x) composed of two elementary bodies (a and b) which have a slighter affinity for each other than one of them (a) has for a third element (c), then if we bring this third body into connection with them under the requisite conditions, the one (a) which has the greatest affinity for it will leave the other (b) and unite with it to form another compound (y). The decomposition of water by red-hot iron illustrates such a case; for if water, which is composed of the elements oxygen and hydrogen, be passed through a tube containing iron filings heated to redness, its oxygen will unite with the iron to form a kind of rust, and its hydrogen will be set free. In every case where one constituent is expelled by a new body, and thus liberated, the decomposition is said to be the result of single elective affinity; but when two substances, each consisting of two constituents, act reciprocally upon each other so as to produce two new compounds, the decomposition is referred to double elective affinity. This double reaction takes place when chloride of phosphorus is thrown into water. The chlorine leaves the phosphorus and unites with the hydrogen of the water to form hydrochloric acid, while the remaining elements, phosphorus and oxygen, enter into combination and produce phosphoric acid. An idea formerly prevailed that the affinity between any two substances never varied, and great labor was bestowed on the preparation of tables exhibiting the precedence of affinities. Modern chemists, however, do not regard affinity as a fixed and regular force, and the tables alluded to are now considered of no use. The attraction of one body for another is greatly modified by the circumstances under which the two bodies are brought together. Alteration of temperature is one of the causes which influence the force of chemical attraction. When metallic mercury is heated nearly to its boiling point, and exposed in this condition to the air for a lengthened period, it absorbs oxygen and becomes converted into a dark red crystalline powder. But the same oxide of mercury, when raised to a still higher temperature, parts with its oxygen, which leaves the mercury in its original metallic state. Insolubility and the power of vaporization are potent disturbing influences. They interfere in almost every reaction and frequently turn the scale when the opposing affinities are nicely balanced. Thus when a solution of lime in hydrochloric acid is mixed with a solution of carbonate of ammonia, a double reaction ensues; carbonate of lime and chloride of ammonium being generated. This result is brought about mainly by the insolubility of the carbonate of lime. Again, a mixture of dry carbonate of lime and chloride of ammonium, when heated in a retort, gives a sublimate of carbonate of ammonia, while chloride of lime remains behind. In this instance the great volatility of the new ammoniacal salt determines the nature of the decomposition.

What is called the nascent state is one very favorable to chemical combination. Thus, carbon and nitrogen refuse to combine with hydrogen under ordinary circumstances; but when these gases are nascent or newly evolved, as when they are simultaneously liberated from some previous combination, they unite readily. Some remarkable decompositions are referred to a peculiar modification of chemical force, to which the term disposing affinity has been applied. The preparation of hydrogen from zinc affords a familiar example of such decompositions. A piece of polished zinc put into pure water remains perfectly bright for any length of time and manifests no power of decomposing the liquid. On the addition, however, of a little sulphuric acid the metal becomes oxidized and hydrogen is freely disengaged. The acid dissolves the oxide as fast as it is produced, and thus keeps the surface of the metal exposed to the action of the water. This function of the acid is perfectly intelligible; but its decomposing influence, under which the oxide is first formed, is not well understood. Affinity is generally much stronger between bodies which are very unlike each other than between bodies which are closely allied. Thus, potassium and sodium tend strongly to unite with chlorine and iodine, but the bodies of each pair do not attract one another with sufficient force to enter into combination. The discoveries of Faraday and others have established the fact that whenever two substances unite to form a compound, they are in opposite electrical conditions, one being electronegative, the other electropositive. This and other facts go to prove that chemical affinity is a particular modification of electrical attraction.—The Humanitarian for October.

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM OR GAS TURBINE.—Gustaf M. Westman, New York City. For the use of steam or compressed gas expansively, to insure a full utilization of the power and reduce the friction to a minimum, this inventor has devised an improved turbine in which the fluid is discharged tangentially from the periphery of the wheel. The wheel is arranged horizontally and a stationary disk connected with the motive agent supply has a series of passages, each terminating at its outer end in a series of channels discharging the motive agent to the inner ends of buckets discharging the motive agent at their outer ends tangential to the periphery of the wheel, the channels standing at angles to the passages, and approximately at right angles to the walls of the buckets.

AUTOMATIC STEAM VALVE.—Lyman A. Hotchkiss, Perry, Pa. For use in connection with automatic injectors for steam boilers, this inventor has devised a valve for automatically stopping the passage of steam upon certain action of the water in connection with which the valve acts, controlling the action of the injector according to the condition of the water in the boiler. The movement of the main valve is effected by a compound auxilary valve working in auxiliary chambers, the operation of the auxiliary valve being effected by means of a float, and when a sufficient quantity of water has been injected into the boiler the lifting of the float stops the flow of water

Railway Appliances.

OIL RESERVOIR FOR CAR JOURNALS.—Charles E. Harrison, Nebraska City, Neb. In oil reservoirs placed beneath the journals on cars and locomotives this invention provides improved means for maintaining a tight dustproof joint between the edge of the reservoir and the journal, the reservoir being also made adjustable to fit it in the usual reservoir, whatever its depth. The invention comprises an oil holder fitting within the casing and having its upper edges flanged outward and fitting the bottom of the journal and its bearing brass, a feeding wick engaging the journal, and a spring beneath the cup holding it in close contact with the journal at all times.

Bicycles, Etc.

BICYCLE HANDLE BAR.—Edward Q. Norton, Daphne, Ala. To prevent numbness of the hands and promote a more equal development of all the muscles in riding, this invention provides a finger rest or bearing on which the fingers may rest, instead of gripping the handle in the usual way, whenever there is an easy stretch of road. A wire or rod is bent to form a ring-like clamp fitting around the handle bar and forming a frame to encircle plates of wood or rubber in which are individual seats for the balls of the fingers, the clamp being also made to embrace the post, holding the device firmly to the handle bar.

BICYCLE RACK.—Walter G. Parsons, Englewood, N. J. This rack is especially designed for use in baggage cars and other places where space is limited, leaving the floor space of cars available for trunks and other baggage. Cross bars are removably supported just beneath the roof of a car, and upon these are slidably held lengthwise bars carrying hooks held at different angles adapted to support the bicycle, the arrangement permitting of considerable adjustment, for supporting the wheel so that it will not come in contact with the baggage, preventing the bicycles from becoming entangled with one another, and facilitating the removal of any particular wheel when desired.

BICYCLE TOOL BAG.—Mark R. Marshall, Jr, Bunkie, La. A tool tray which holds the tools ready for use on the bicycle, without the necessity of removing it when the tools are to be used, is provided by this invention. The body of the bag is in the form of a shallow box, provided with straps to facilitate attaching it in vertical position to the frame of the machine, and in the bottom of the body is hinged a tray adapted to swing in and out of the body portion, the tray being divided by partitions into compartments adapted to securely hold the tools when the tray is in either a vertical or a horizontal position.

Electrical.

TELEPHONE REPEATER.—William H. M. Weaver, Macon, Ga. To repeat telephonic sound waves, either of speech or music, this inventor has devised a special arrangement of receivers and transmitters in connection with a common return wire, or earth circuit, forming four circuits, the arrangement being designed to reduce the cost of building lines for long distance work, as the repeaters may be cut in circuit at intervals. By connecting the repeater with local instruments in halls or other public places, mounting apparatus on proper sounding boards, etc., entertainments, operas, speeches, etc., may be listened to by audiences between cities.

Mechanical.

PUMPING APPARATUS.—Charles E. and David M. Newell, Franklin, Pa. A power-transmitting apparatus devised by these inventors is especially designed for the transmission of power from a motor to the pumps of oil or other wells. On a cement base is mounted a block forming a right-angled triangle, a shaft being held perpendicular to the base by sectional boxes, the latter being held to the base and held in position by tie rods. The shaft turns freely in the boxes and is stepped on ball bearings, and fixed to the upper portion of the shaft is a pulley on which is a belt by which power is received, there being also on the shaft an eccentric by which power is transmitted from the shaft by a pitman.

ROCK DRILL.—Albert M. Plumb, Colorado Springs, Col. This invention is for an improvement on a formerly patented invention of the same inventor, rendering the construction more simple, durable and inexpensive, and providing an effective feed and striking movement for the plunger carrying the drill. A spring is coiled around the reduced rear end of the plunger, there being means for changing the compression of the spring upon the plunger and thus regulating the force of the blow, as the plunger is drawn backward by a segmental gear to compress the spring, the disengagement of the gears releasing the plunger to force the drill forward to engagement with the work.

FLUE CLEANER.—George E. R Rothenbucher, Bloomfield, N. J. This device has transverse cutters or jaws with bevels inclined forwardly and rearwardly, some of the jaws being perpendicular to the scraper's axis, the cutters of the jaws being adapted to cut into the scale on the inside of the flue as the operator pushes the cleaner inward and at the same time turns it by means of a handle. A following brush removes and pushes out the particles, steam being afterward passed through the flue by means of a branch connection with a steam supply pipe.

Agricultural.

MOULDBOARD.—Samuel A. Smith, McKinney, Texas. This invention covers an improvement on a formerly patented invention of the same inventor, simplifying the construction and arranging for the vibratory parts of the board being in independent sections, enabling one or more of the sections to be replaced without disturbing other parts or sections. These mouldboards are particularly adapted for use on what are known as "black lands," the mouldboard being given a vibratory action on contact with the earth passing over it, such motion tending to prevent the clinging of the earth to the mouldboard.

GUANO DISTRIBUTER.—John B. Kimbell, Alpharetta, Ga. This distributer for guano and other fertilizers may be readily attached to a plow or other agricultural implement, and consists of a hopper having a ground wheel on one end of the axle of which is a crank arm, there being in the hopper a distributing slide provided with pockets, its ends projecting through the hopper, while an arm on the ends is connected to a pitman which is also connected to the crank arm. The amount of fertilizer to be distributed may be regulated as desired.

HORSE RAKE ATTACHMENT FOR GRAIN BINDERS.—John M. Lytle, White Hall, Md. This attachment is designed to allow the grain to be cured in the swath as it lies loose on the ground, the grain to be then raked up by the machine and bound. The rake comprises an endless elevator having tines in the rear of which are guard rods and a series of rake teeth in the rear of the guards, the teeth having yielding knuckle joints and shanks with tubular extensions within which are spiral springs and rods. The grain passes up between the rake teeth and the guards to be delivered to the binding table or platform of any of the binding devices now in use, the guards clearing the grain from the fingers of the elevator belt.

Miscellaneous.

ELEVATOR SAFETY DEVICE.—Hugh Baines, Brooklyn, N. Y., and Alphonzo E. Pelham, New York City. For elevators which have governors to control the speed of descent, this invention provides improvements with a view of locking the elevator carriage when it travels too fast, or in case the governor gets out of order and fails to act, or in the event of the breaking of the hoisting cable. The shaft has guiding surfaces and a stationary rack, and the carriage has a bar movable into and out of engagement with the rack, mechanism driven by the movement of the carriage causing the bar to engage the rack teeth successively, while a clutch device is connected to the bar and operated by its prolonged engagement with the rack when the mechanism fails to act, the clutch device being adapted for engagement with the guiding surfaces of the shaft.

FIRE BRICKS, ETC.—William H. Brock, Brooklyn, N. Y. For bricks to be used in boiler settings, etc., this invention provides a fire cap or upper part of the setting of simple and durable construction, designed to hold the bricks in place notwithstanding their shrinkage from heat, the invention consisting principally of bricks formed at adjacent faces and ends with registering elongated recesses and keys of corresponding shape, each extending into and filling the corresponding registering recess of two adjacent bricks. The improved construction may be employed to advantage wherever a strong bond is desired, absolutely preventing any sliding movement of the bricks relatively to the keys or to each other.

FISH HOOK HOLDER.—Horatio H. Garland, Brooklyn, N. Y. This improved holder is designed to facilitate conveniently storing a large number of hooks and their snells in small space, the points of the hooks being well protected and the snells held straight, permitting of the ready removal by the fisherman of any desired hook or snell, without disturbing the others. The holder has at each end forks provided at their outer ends with lugs or projections, the ends of the hooks being passed between the members of the forks and held in place by the projections, while the snells are engaged by an elastic band hooked upon a projection at the opposite end of the holder.

FASTENER SETTING DEVICE.—William Scheuer, New York City. This invention provides a ratchet punch especially adapted for securing buttons, hooks, etc., in the uppers of boots or shoes or other material. The device has a revolving head in which the buttons, hooks, etc., may be carried and from which they may be conveniently disengaged, the head having a timed movement by means of the ratchet to carry the button or hook to the point where it is to be affixed.

BOTTLE CLOSURE.—Alexander McLeod, Brisbane, Queensland. With this stopper it is necessary to break off the top of the neck of the bottle before the cork proper can be removed. The bottle neck has an annular indentation, and the upper portion of the neck, above this indentation, has a recess, in which extend spring arms extending downward from a cap plate on top of the cork, it being impossible to remove the plate and cork until the top portion of the bottle neck is broken off.

NURSING BOTTLE.—Thomas W. M. Worley, New York City. The neck of this bottle has a screw thread and annular bead at the edge, the cap having a thread to engage the thread of the neck, whereby the rubber nipple will be securely held on the bottle neck, and no metal or other substance will come in contact with the milk.

Designs.

KNIFE SHARPENING JAW.—Michael Nielsen and Thomas S. Thomsen, Greenwich, Conn. This jaw is in tubular form, with a peripheral surface which presents a series of annular steps, each having a flat surface and a tapering surface.

PICTURE FRAME.—Izak V. Arvonen, Calumet, Mich. This design consists of a floral wreath apparently resting upon a larger scroll wreath of ribbon type, stars being connected with the floral wreath, and an ornamental inner border, there being also a representation of a flag and an eagle on the flagstaff.

FRAME OR BODY FOR MUSICAL INSTRUMENTS.—Herman C. Levin, New York City. This design is for a twin body with two openings for parallel necks, the necks terminating one short of the other and being disconnected from and independent of each other.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

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NEW BOOKS, ETC.

NINTH SPECIAL REPORT OF THE COMMISSIONER OF LABOR. The Italians in Chicago. A Social and Economic Study. Prepared under the direction of Carroll D. Wright. Washington. 1897. Pp. 409.

EUCLID: Books I-IV. By Robert Deakin. The University Tutorial Series. London: W. B. Clive. New York: Hinds & Noble. Pp. 309. Price 70 cents.

The object of the extensive series of books, of which this forms one of the volumes under the department of mathematics and mechanics, is to provide candidates for examinations and learners generally with text books which shall convey, in the simplest form, sound instruction, in accordance with the latest results of scholarship and scientific research. The writer of this volume has had more than twenty years' experience in teaching Euclid to large and small classes, and this book presents the results of his endeavors to reduce the labors of teachers and students.

MANUAL OF HYDRAULIC MINING. By T. F. Van Wagenen. New York: D. Van Nostrand Company. Pp. 95. Price $1.

A second edition of this excellent little hand book comes out very appropriately at this time, when, on account of the general interest felt in the Klondike region, so many people are desirous of learning something of practical mining operations. This book necessarily does not claim to cover the whole subject, with all its engineering problems, but is written for the practical working miner, who will here find valuable details and much to aid him in intelligent prospecting, while guiding his judgment in the actual work.

LETTERING FOR DRAFTSMEN, ENGINEERS AND STUDENTS. By Charles W. Reinhardt. New York: D. Van Nostrand Company.

To facilitate attaining excellence in purely freehand lettering is the object of the simple lessons and numerous plates and other illustrations presented in this volume, by a draftsman of high attainments. The author does not present ornate, carefully engraved alphabets, but such as may be readily mastered, enabling the draftsman to do the best class of work in the shortest possible time.

SLIDE VALVES. By C. W. MacCord, Jr., M.E. New York: John Wiley & Sons. Pp. 168. Price $2.

This is a book for practical men, on principles and methods of design, with an explanation of the principles of shaft governors. The book contains 101 illustrations, and its subject matter comprises a revision and rearrangement of articles heretofore presented in a mechanical and engineering serial publication.

CHEMISTRY FOR PHOTOGRAPHERS. By Charles F. Townsend, F.C.S., F.R.P.S. New York: Spon & Chamberlain. Pp. 158. Price 75 cents.

This simple and practical hand book is designed to be of especial value to the beginner and amateur, as well as affording a valuable text book for the experienced photographer. Its explanations of the chemistry of the subject are as simple as it seems possible to make them, and its treatment of developers and various printing processes covers a wide range.

BIBLIOGRAPHY OF X RAY LITERATURE AND RESEARCH. Edited by Charles E. S. Phillips. New York: D Van Nostrand Company. Pp. 68. Price $2.

This book contains a historical retrospect of and a ready reference index to the literature of a subject which has occupied a very prominent place in the public mind for the last eighteen months. The editor also adds a chapter giving practical hints on setting up and operating apparatus for this description of work.

REPERTORIUM DER TECHNISCHEN JOURNAL-LITTERATUR. Herausgegeben im Kaiserlichen Patentamt. Jahrgang 1896. Berlin: Car Heymanns Verlag. 1897. Pp. 563. Price $4.50.

The present bibliography is of great value to all those who are interested in the technical literature of the day. It is interesting to note the number of papers which have been read to obtain the entries. The entries are made in the language in which the articles are published, and an excellent index renders the whole collection of value to the English-speaking reader.

COMMERCIAL DIRECTORY OF THE AMERICAN REPUBLICS. Compiled by the Bureau of American Republics, International Union of American Republics, Joseph P. Smith, Director. In two volumes. Washington. 1897. Pp. 1069.

This volume comprises the addresses of manufacturers, merchants, shippers, banks and bankers engaged in foreign trade, together with the names of official maps, commercial statistics, industrial data and other information concerning the countries of the International Union of American Republics, the American Colonies and Hawaii. This volume treats of the Argentine Republic, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Falkland Islands, the greater republic of Central America, Guatemala, Guianas, Haiti, Hawaii, Honduras and British Honduras. This book will prove of value to those interested.

CARPENTRY AND JOINERY. A Text Book for Architects, Engineers, Surveyors and Craftsmen. Fully illustrated and written by Banister F. Fletcher and H. Phillips Fletcher. London. 1898. Pp. 293.

One of the authors of the present book is the author of "A History of Architecture," which will long rank as one of the important works upon the subject. It is chiefly notable for its remarkable analysis of the various styles. In the present book the authors have made a concise treatise both for reference and for the instruction of students on the important subjects of carpentry and joinery. Of course, the practice is English practice, and some of the tools appear queer enough to American eyes. Still, the chapters relating to joints used in carpentry, roofs, scaffolding, floors, framing, etc., certainly are of value to the student. There are 420 illustrations in the book. They serve admirably to elucidate the text.

HIGH MASONRY DAMS. By E. Sherman Gould. New York: D. Van Nostrand Company. 1897. Pp. 88. Price 50 cents.

The present volume replaces the original number 22 of the Van Nostrand Science Series, bearing the same title by John B. McMaster. The splendid treatise of Mr. Wegmann upon the same subject has so completely superseded all other treatment of the mathematical features involved that it would be useless to revive old material. The present work cannot but prove of value to all civil engineers.

A MANUAL OF FISH CULTURE. Based on the Methods of the United States Commission of Fish and Fisheries. With Chapters on the Cultivation of Oysters and Frogs. Washington. 1897. Pp. 340.

This is a very valuable book containing an excellent description of the modern methods of fish culture as carried on by the remarkable bureau known as the United States Commission of Fish and Fisheries. It is illustrated by 35 plates.

Received.

STIRPICULTURE; or, the Improvement of Offspring through Wiser Generation. By M. L. Holbrook, M.D. New York: M. L. Holbrook & Company. Pp. 192. Price $1.

THE KING'S DAUGHTER AND THE KING'S SON. By a King's Daughter. New York: Fowler & Wells Company. Pp. 288. Price $1.

TRUE DETECTIVE STORIES. From the archives of the Pinkertons By Cleveland Moffett. New York: Doubleday & McClure Company. Pp. 250. Price $1.

LEE'S VEST POCKET POINTERS FOR BUSY PEOPLE. A Ready Reference Manual. Chicago: Laird & Lee. Pp. 230. Price, morocco, gilt, 50 cents.

WHIP AND SPUR. By Col. George E. Waring, Jr. New York: Doubleday & McClure Company. Pp. 245. Price $1.

NOT IN IT. By Anna Olcott Commelin. New York: Fowler & Wells Company. Pp. 96. Price 75 cents.

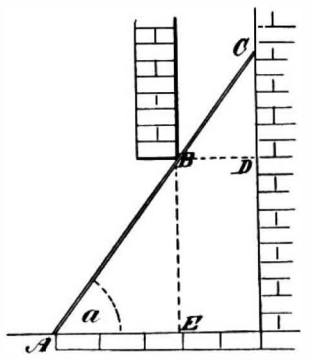
Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(7292) W. H. asks: 1. What current and E. M. F. are used with the electric needle in removing hairs from the body? A. About 6 cells of carbon zinc battery, bichromate plunge battery, will do it. For battery, see SCIENTIFIC AMERICAN SUPPLEMENT, No. 792, 10 cents. 2. Am I right in supposing one electrode is held to some part of the body and the other placed to base of hair to be removed? A. Yes. 3. What kind of needle is necessary? A. Platinum. 4. Is a direct or alternating current required? A. Direct. 5. What SUPPLEMENT treats on the subject? A. See "Medical and Surgical Electricity," by Beard and Rockwell, page 538, price $5.50 by mail.

(7293) J. S., New City, N. J., writes: 1. Will some of your correspondents of the SCIENTIFIC AMERICAN give the solution of the following problem? What is the longest straight pole that can be run up a chimney, the height of the mantel being 48 inches and the depth from front to back 16 inches? A. Solution by C. W. L. Filkins, C.E., Instructor in Mathematics, Adelphi College, Brooklyn, N. Y.:



Let A C = l; B D = b; B E = m b.

Then by right triangles—

$$B C = \frac{b}{\cos a}; \text{ and } A B = \frac{m b}{\sin a}$$

but l = B C + A B.

$$\therefore l = b\left[\frac{m}{\sin a} + \frac{1}{\cos a}\right]$$

For maximum l.

$$\frac{d l}{d a} = 0 = b\left[\frac{-m \cos a}{\sin^2 a} + \frac{\sin a}{\cos^2 a}\right]$$

Whence $m \cos^3 a = \sin^3 a$

and $\tan^3 a = m$

$$\therefore a = \tan^{-1} \sqrt[3]{m}$$

$$\therefore l_{(m b x)} = b\left[\frac{m}{\sin(\tan^{-1}\sqrt[3]{m})} + \frac{1}{\cos(\tan^{-1}\sqrt[3]{m})}\right]$$

Make m = 3, by condition of problem, and

$$a = \tan^{-1}\sqrt[3]{3} = 55° 15' 50.6''$$

$$\therefore l_{(m b x)} = b\left[\frac{3}{\sin 55° 15' 50·6''} + \frac{1}{\cos 55° 15' 50·6''}\right]$$
$$= 5·4056\ b.$$

If b = 16 inches—

$$l_{(m b x)} = 86·49 \text{ inches}$$
$$= 7 \text{ feet } 2\tfrac{1}{2} \text{ inches, nearly.}$$

2. Please give the best method for calculating change gears for screw cutting foot lathes, both simple and compound. A. Rule for gearing lathes for screw cutting: Read from the lathe index the number of threads per inch cut by equal gears, and multiply it by any number that will give for a product a gear on the index; put this gear upon the stud, then multiply the number of threads per inch to be cut by the same number, and put the resulting gear upon the screw. For compound gear: If the gear on the compound stud is two to one, then multiply the threads on the leading screw by two and proceed as above. See Kent's "Mechanical Engineer's Pocket Book," $5.00 by mail, which gives tables and rules for other compound gears.

(7294) E. E. D. asks: When was the last total eclipse of the sun? Give the day and the date. (Visible in the United States.) A. The last total eclipse of the sun, visible in the United States, occurred on January 1, 1889. The line of totality ran from California through Nevada, Idaho, Montana, and North Dakota.

(7295) B. asks: Will you kindly give in SCIENTIFIC AMERICAN a description of the process for enlarging pictures, making life size portraits from small photos, tintypes, etc.? A. Valuable information on photo-enlarging and enlarging apparatus is contained in our SUPPLEMENT, Nos. 451, 977, and 1053, price 10 cents each by mail.

(7296) J. G. B. asks: What per cent loss would be advisable to figure on electrical circuits of different voltage, say 2,000, 1,000, 500, 220, 100 volts? What is the customary loss on different voltages? A. The drop in voltage on a line should be very small indeed, only a few volts, not one per cent.

(7297) G. W. asks: 1. How can electric motor described in SUPPLEMENT, No. 641, be wound for a dynamo by using cast fields, so that it could be used to charge a storage battery? A. You do not need to rewind motor of SUPPLEMENT, No. 641, to use it as a dynamo, provided it has a cast iron field magnet. Drive it with power and it will give out current. It is then a dynamo, and will charge three storage cells in series. 2. How many lamps would it run, and what candle power? A. It will light three or four 4 candle power lamps. 3. What kind of armature do you suggest? A. It does not require any change.

(7298) W. M. M. asks: 1. What theoretical per cent advantage is gained by the substitution of say ¾ inch balls for ⅜ inch balls in the ordinary bicycle bearing? A. The only theoretical advantage that can be derived from the larger ball may be found in the greater rolling diameter; but practically, the increased bulk of balls and hub will make any theoretical advantage a negative quantity. 2. Will you give a formula for the determination of the above by which other sizes may be calculated? A. The problem is a practical one, depending entirely upon the admissable size and weight of the hub and its mechanism. There is no formula that will apply to a case having so wide a range of practice in construction as the ball bearing system has developed. 3. Theoretically, is the contact in the two or three point contact ball bearings now in common use a purely rolling contact, or is it a combination of rolling and sliding contacts? A. The two-contact system of ball bearings is essentially a purely rolling contact. The three-point contact system may be a combination of rolling and sliding contact and subject to considerable friction. 4. Theoretically, are both these forms of bearings equally correct and free from friction, and if not, which is the more correct form? A. Both systems are correct in regard to some requirement of design and condition of construction. Theoretically, the two-contact system is the more efficient as regards friction.

(7299) J. A. R. says: Please give in your next issue what you consider the best combined toning and fixing bath formula for solio paper. A. 1. For solio paper use the formula recommended by the makers. The following are formulas for combined baths. The operation of toning and fixing is much simplified by using the combined bath. The print coming out of the printing frame is left in the bath till the color is arrived at, then washed and dried. The bath is composed of two solutions, and will keep for a long time. Dissolve water 24 ounces; hyposulphite of soda, 6 ounces; sulphocyanide of ammonia, 1 ounce; acetate of sodo, 1½ ounce; saturated solution of alum, 2 ounces. Fill the bottle containing the solution with scraps of sensitized paper, bad prints that are not fixed, and leave it for a day. Then filter and add the following solution: Water, 6 ounces; chloride of gold, 15 grains; chloride of ammonium, 30 grains. It is necessary to print deep enough, and to leave the prints in the bath till, in looking through them, the desired color, brown dark or bluish, is observed. Used for Omega and other paper.

2. Chloride of gold	1 gr.
Phosphate of soda	15 "
Sulphocyanide of ammonium	25 "
Hyposulphite of soda	240 "
Water	2 oz.

Dissolve the gold separately in a small quantity of water and add it to the other solution.

3. Water	32 oz.
Hypo	8 "
Chloride of gold	15 "
Nitrate of lead (c. p.)	75 "

(7300) E. F. R. writes: 1. I am building a telephone from the circuit described in "Experimental Science," on page 582 of the edition of 1890, and want to know if an induction coil of 150 ohms will work properly on a short line of about 250 feet with return wire, also, if two batteries will be sufficient to call over the line if it is iron wire or should I use copper wire, and what size? A. The primary of the induction coil has a resistance of about 0·5 ohm; the secondary, about 150 ohms. One cell Leclanche battery will be sufficient at each end of the line. For so short a distance the regular No. 12 A. W. G. galvanized iron wire will answer very well. 2. Will a Hunning type transmitter do? A. Yes.

(7301) J. H. C. asks: 1. How much power can be realized from a water wheel of five hundred horse power capacity running a dynamo, the dynamo to operate motor three miles away? A. About 375 horse power, if modern machines are used, and line properly constructed. 2. What size wire would it take, and what voltage would be most satisfactory? A. Using the three phase system for transmission, with a loss of 5 per cent in the line, you would require three wires each number 0 0 0 0 B. and S. Particular conditions may change the size of wire a trifle. Generate the current at a potential of 1,000 volts two phase, step up to 3,000 volts by means of transformers and transmit by three phase to save copper. If energy is to be used for both light and power, it can be transformed at the receiving end to 120 volts two phase. This gives you the advantage of the three phase for transmission and that of the two phase for generating and distribution. Alternating.

TO INVENTORS.

An experience of nearly fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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DECEMBER 28, 1897,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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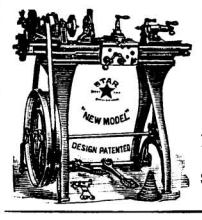

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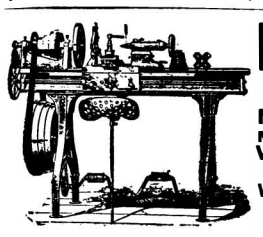

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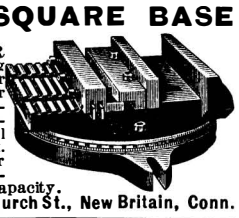

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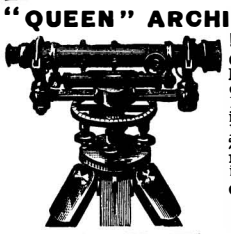

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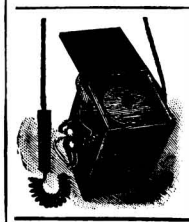

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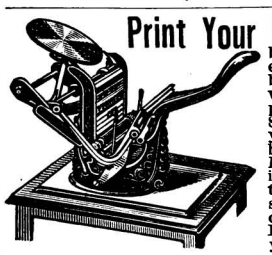

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